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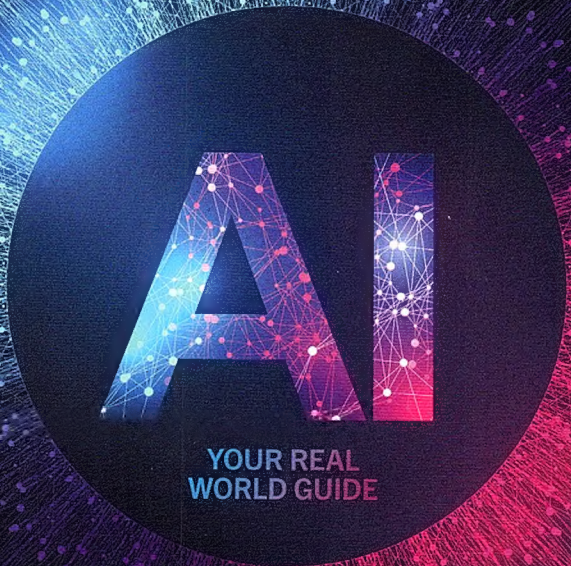
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Vigor2927ax (Wi-Fi 6, AX3000)

- 1 x fixed GbE WAN port and 1 x configurable GbE WAN/LAN port for Failover, Load Balancing and High Availability mode
- Two USB 2.0 ports for connection to two 3G/4G LTE USB modems, FTP server, network printer and thermometer
- 5 x Gigabit LAN ports with multiple subnets and 60,000 NAT sessions
- 50 x VPN tunnels (including 25 x OpenVPN/ SSL-VPN tunnels) with comprehensive secure protocols
- Fast VPN throughput, VPN load-balancing and backup for site-to-site applications
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- High Availability mode
- Object-based SPI Firewall and CSM (Content Security Management) for network security
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- SD WAN capability when used with VigorACS 3
- Central VPN Management for 8 remote Vigor routers
- Central AP Management for deployment of 20 VigorAP's
- Central Switch Management for 10 VigorSwitches
- 2 years back to base warranty

Vigor2135 Series

Broadband routers with 4 x GbE LAN ports, SPI Firewall, 802.11ax/ac Wi-Fi and 2 x VPN tunnels including SSL-VPN tunnels



Vigor2135ax (802.11ax, Wi-Fi 6)

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- 1 x Gigabit WAN port with 2 x USB ports for 3.5G / 4G Mobile Failover
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- NAT throughput over 600Mbps
- IPsec VPN throughput at 150 Mbps (AES 256 bits)
- Object-based SPI Firewall, Content Security Management (CSM) and QoS
- IPv6 & IPv4
- Integrated IEEE 802.11ax (AX3000) wireless Access Point (ax model)
- 802.11ac (AC1300) Wi-Fi up to 400 + 867Mbps speed (ac/Vac model)
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- 2 years back to base warranty



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EDITORIAL

WHAT'S INSIDE APC



EDITORIAL

Money-wise

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BEN MANSILL
Likes nice things.

Hi everyone. I hope 2023 is being kind to you, and that your regular fix of APC is helping entertain and inform you as the march of tech moves ever forward.

First, some housekeeping. If you bought this issue from a shop or newsagent, you may have noticed that it cost a dollar more than usual. From this issue on, APC's cover price has increased from \$10.95 to \$11.95. We've held off as long as we can, but it costs a bit more to print and distribute APC now, so we had to put it up to continue producing this wonderful magazine. We've kept the rise to the minimum possible, and if you're a regular reader you'll know that we do this extremely rarely.

Your understanding and support is greatly appreciated, and I mean that most sincerely.

What hasn't changed is the subscription price. That still sits at just \$5.79 per issue with a 24-issue subscription, and if you choose the digital edition instead it's only \$4.99 an issue. We can't guarantee how long this low price will last, but at more than 50 percent off the newsstand price it's a pretty sweet deal that keeps APC coming without missing a single issue, and all conveniently home delivered.

You can see how easy and cheap it is to subscribe on page 20. So don't delay, and secure your APC at a bargain price now.

I hope you agree that it's well worth the relatively low cost to have such high quality tech content come to you. In this issue we've jumped into the insanely rapidly evolving world of AI, but instead of trying to make sense of the incredible tech behind the scenes, we've focussed on how AI can help you. It's already an immensely powerful tool that's ready right now to help you with your work, studies, or passions.

And this is just the beginning! AI is such a paradigm leap that it's essential to stay on top of what's happening now, and that's what we're offering in this issue, and you can be sure it's a topic we'll be covering closely as it evolves.

We've got a great guide to restoring old photos and videos, as well as adding colourful new life to ancient images. We all have irreplaceable memories of friends and family, and with our guide you can keep these priceless treasures in the perfect condition they deserve.

We all hope you have a great month, and we'll see you next issue.



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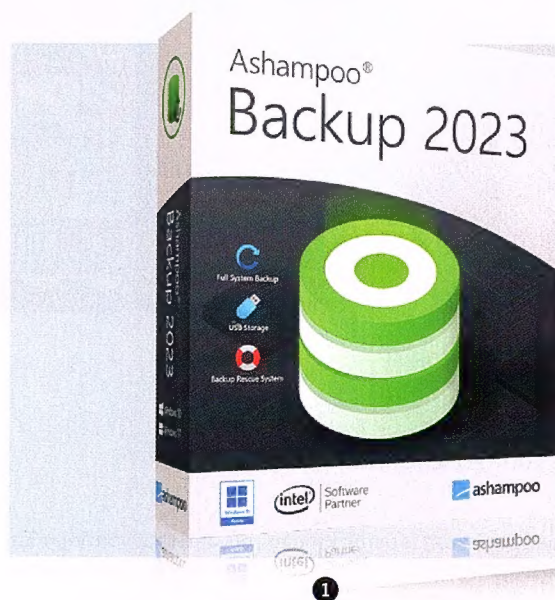
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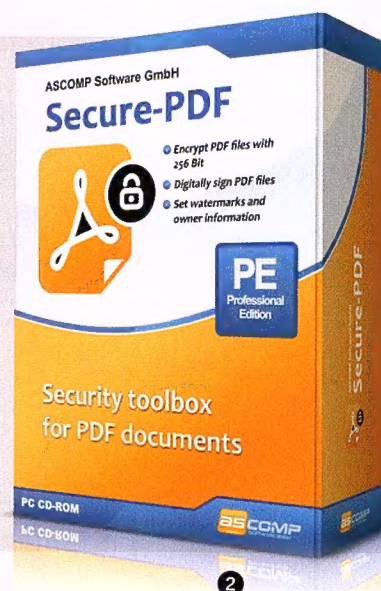
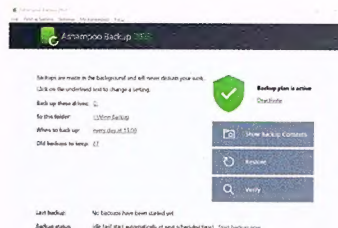


ASHAMPOO BACKUP 2023

Backup and restore files extensively in just a few clicks!

If you've ever stared at a black screen because your Windows refused to boot, you'll appreciate the value of regular backups. And it can be so easy! Only backups will protect you against impending data loss, as caused by ransomware, a corrupt operating system or disks. Ashampoo Backup 2023 is the fool-proof backup software to save your files. The program backs up and restores entire partitions and disks in just a few clicks. Benefit from automated backups and fuss-free file recovery through the built-in rescue system! With Ashampoo Backup 2023, you decide where your backups will be stored, whether it's a local network or external drive. This backup software was designed as a carefree fire-and-forget solution for users who don't want to spend too much time thinking about file safety. It's the easiest backup software on the market.

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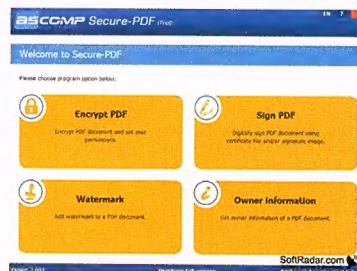


ASCOMP SECURE-PDF

Security toolbox for PDF files including encryption and signing.

The PDF format is used worldwide to distribute graphically processed documents. However, editing the documents is usually associated with high costs because good PDF editors are quite expensive. The cheaper alternatives on the other hand, lack the important functions to make PDFs secure, for example by encrypting, digitally signing or adding watermarks. Secure-PDF puts an end to this: Encrypt your own or other people's PDF documents with up to 256 bit key strength (AES). Add a password to open it so that users can only view the encrypted document by entering the correct password.

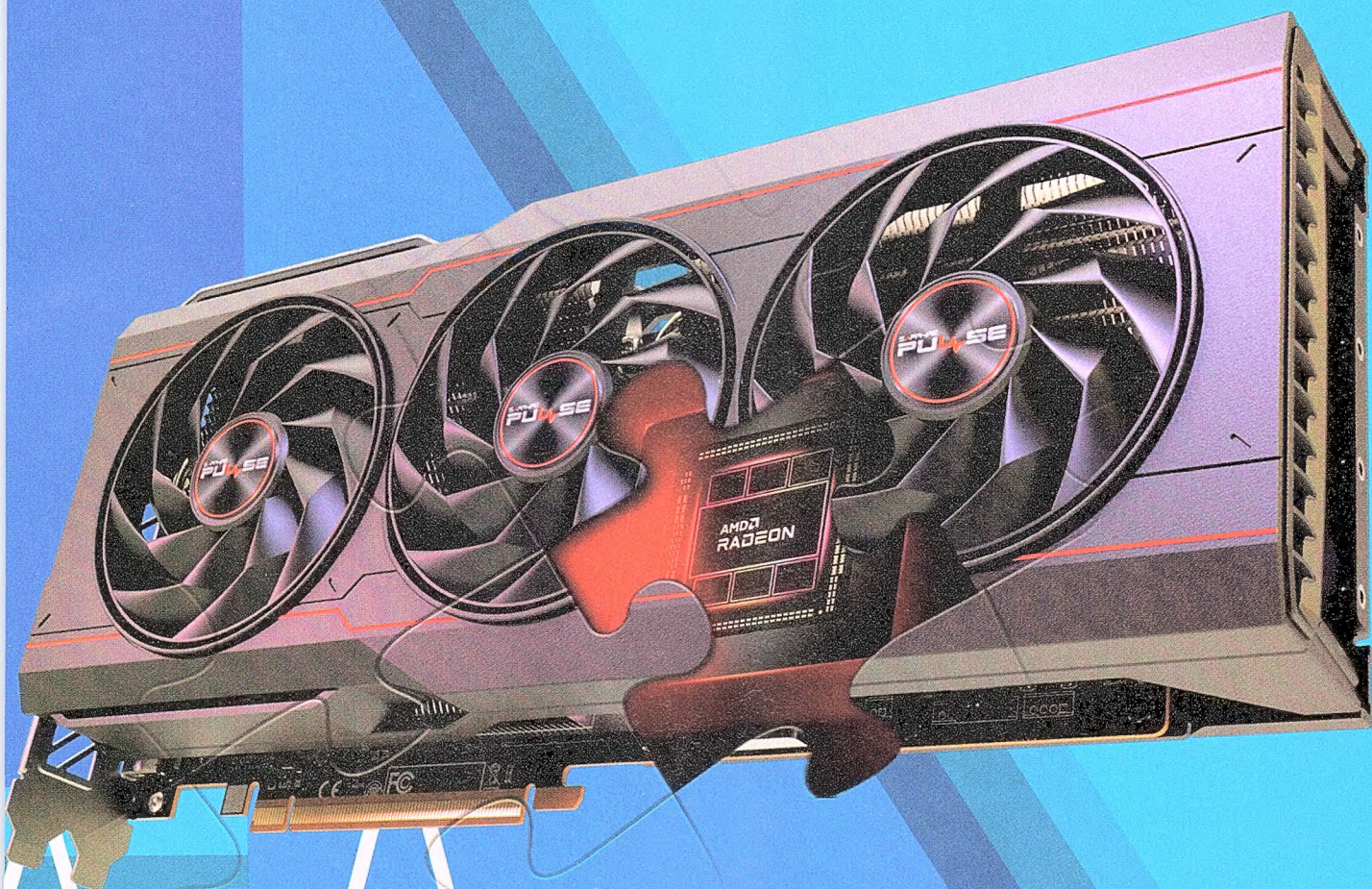
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RX 7900 XT

SAPPHIRE
PULSE

High TG Copper PCB | Fuse Protection | Precision Fan Control
Metal Backplate with Thermal Pad | Two-Ball Bearing Fans | Angular Velocity Fan Blade

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AI

YOUR REAL
WORLD GUIDEWRITE YOUR REPORTS • GENERATE IDEAS • SUMMARISE MEETINGS
SIMPLIFY EMAILS • DELEGATE DULL JOBS FOREVER!MAKE IT WORK
FOR YOU

PART 5

RESTORE
YOUR OLD
PHOTOS
& VIDEOS

Don't pay to repair damaged photos and poor quality videos. Robert Irvine reveals how to master the most effective free methods, to preserve your precious memories forever. **PAGE 084**

(R)EVOLUTION OF PORTABLE AUDIO
Back in a flash

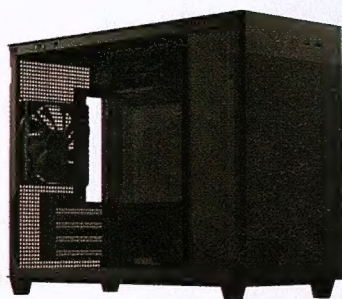
The path to portable digital music would be potholed with failed products and legal threats, but as Darren Yates writes, it was the personal computer that finally brought music into the 21st century. **PAGE 056**



INTEL ARC A750
Exceeding expectations
032



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HOW WE DO IT

Inside APC

Find out all about APC's editorial policies, test practices, how to read the benchmark results, and more.



"Championing technology doesn't mean we're unrelenting yes-men and -women, however, and APC aims to be as objective as possible in all our coverage."

APC is Australia's oldest consumer technology magazine – having been consistently in print for over forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, APC's journalists want to know what's good in tech – no matter what platform it resides on.

Independent reviews

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter offers better ease-of-readability, but tables are more compact, so we use these in most cases where thoroughness is preferred.

UPDATED FOR 2023

apc TESTBED

The current APC testbed used in the Labs for benchmarking all components. This testbed is updated as new and relevant technology comes on stream.

CPU	Intel Core i9 12900K
Motherboard	Asus Maximus Z690 Apex
Graphics Card	Nvidia GeForce RTX 4090 Founders Edition
RAM	2x16GB G.Skill Trident Z5 DDR5-6000
Power Supply	Corsair AX1000
Storage	Seagate Firecuda 530 2TB
Case	Thermaltake Core P8
Cooling	Cooler Master Flux PL360 AIO
Operating system	Windows 11 Pro 22H2

apc AWARDS



APC EDITOR'S CHOICE

When a product scores 4.5 out of 5, it carries the Editor's Choice Award. These are products that exceed expectations and deliver a quality experience up there with the very best.



APC HIGHLY RECOMMENDED

You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.



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DISPLAY



ROG STRIX G16

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Brand new 16-inch Nebula Display, 16:10 aspect ratio



Game with confidence thanks to Tri-Fan Technology, full-surround vents, and Conduction Extreme liquid metal



Dolby Vision and Dolby Atmos support for immersive content



Multiple RGB lighting zones with per-key customization are easily synchronized with Aura Sync

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VALVE TO KILL STEAM GAMING ON WINDOWS 7 AND 8

Windows update holdouts have until January 1, 2024 to comply.

Steam, the world's most popular PC gaming client, community, and store, will shut its doors to Windows 7, 8, and 8.1 users next year. The cut-off date for Windows upgrade holdouts is January 1, 2024. To be clear, from January 2024, Windows 10 will be the oldest Windows OS that is compatible with the Steam Client.

In the latest Steam Hardware Survey, Windows accounts for 96.4 percent of gamers. Windows 10 and 11 are by far the most popular versions, with 62.3 percent and 32.1 percent of users, respectively. Meanwhile, earlier versions of Windows (7 and 8.1) add up to just 1.9 percent of all users – and continue to slide in the popularity stakes.



© Nvidia

NVIDIA USES AI TO OPTIMISE CHIP DESIGNS

AI can help find optimal chip design solutions.

Nvidia looks set to be one of the pioneers in applying AI to chip design. At the end of March it published a paper and blog post revealing how its AutoDMP system can accelerate modern chip floor-planning using GPU-accelerated AI/ML optimisation, resulting in a 30X speedup over previous methods.

In one of Nvidia's examples of AutoDMP at work, the tool leveraged its AI on the problem of determining an optimal layout of 256 RSIC-V cores, accounting for 2.7 million standard cells and 320 memory macros. AutoDMP took 3.5 hours to come up with an optimal layout on a single Nvidia DGX Station A100. That's a 30x speedup compared to previous methods of placement.

AI

Tech titans call for immediate pause of AI training

Musk, Wozniak and others want the development of AI to be paused.

Artificial intelligence is one of the hottest topics in tech, but some are calling for further guidance and regulation before labs push AI further. Future of Life Institute penned an open letter calling for the immediate pause of all AI training for systems more powerful than GPT-4. The institute suggests a pause of at least six months to design, develop, and implement protocols for using AI safely.

"Should we let machines flood our information channels with propaganda and untruth? Should we automate away all the jobs, including the fulfilling ones? Should we develop nonhuman minds that might eventually outnumber, outsmart, obsolete and replace us? Should we risk loss of control of our civilisation?" reads the letter.

It continues, stating, "powerful AI systems should be developed only once we are confident that their effects will be positive and their risks will be manageable."

While you may have not heard of Future of Life Institute, you've likely heard of the people who have signed the institute's open letter. Elon Musk and Steve Wozniak are among over 1,100 names currently attached to the letter.

That list also includes a Turing Prize winner, several university professors, and the co-founder of Skype Jaan Tallinn.

The call to action states: "We call on all AI labs to immediately pause for at least 6 months the training of AI systems more powerful than GPT-4. This pause should be public and verifiable, and include all key actors. If such a pause cannot be enacted quickly, governments should step in and

institute a moratorium."

Below are some of the more noteworthy names that have signed the letter. The entire list is at the bottom of the letter: **Yoshua Bengio**, Founder and Scientific Director at Mila, Turing Prize winner and professor at University of

"Should we let machines flood our information channels with propaganda and untruth? Should we automate away all the jobs, including the fulfilling ones?"

Montreal

Stuart Russell, Berkeley, Professor of Computer Science, director of the Center for Intelligent Systems, and co-author of the standard textbook "Artificial Intelligence: a Modern Approach"

Elon Musk, CEO of SpaceX, Tesla & Twitter

Steve Wozniak, Co-founder, Apple
Jaan Tallinn, Co-Founder of Skype, Centre for the Study of Existential Risk, Future of Life Institute

Evan Sharp, Co-Founder, Pinterest

Gordon Moore, Intel Co-Founder and creator of Moore's Law, dies at age 94

The passing of a legend.



on March 24th, surrounded by his family in Hawaii, at the age of 94. Moore co-founded Intel with his longtime friend Robert Noyce in 1968,

Intel and the Gordon and Betty Moore Foundation announced that Intel co-founder Gordon Moore died peacefully

but is perhaps best known as the creator of the eponymous Moore's Law.

Moore's Law, originally penned in 1965, stated that the number of transistors on an integrated circuit would double every year. This law served as a goal that helped drive the semiconductor industry forward.

In 1975, Moore revised this law to predict a doubling of transistors every two years, which, despite plenty of debate, has largely continued to hold true to this day.

© Intel



Disney CEO axes metaverse unit

Bob Iger apparently believes it's not right for Disney.

Disney is exiting the metaverse, at least for now. The *Wall Street Journal* reports that the House of Mouse has completely axed its "next-generation storytelling and customer experiences unit," the blandly-titled division of its business responsible for its metaverse strategies.

The unit's head, Mike White, gets to stay at Disney, but the 50-or-so staff members under him haven't been so lucky. All of them will have to find new jobs.

It seems Iger isn't quite as enamoured with the metaverse as his predecessor, Bob Chapek. It was Chapek who hired

White, back in 2022, and who told investors in a November 2021 earnings call that Disney's "efforts to date are merely a prologue to a time when we'll be able to connect the physical and digital worlds even more closely," at which point the company would achieve "storytelling without boundaries in our own Disney metaverse".

The metaverse has been strangely and mercifully quiet lately, and it seems like multiple companies are backpedalling a little from the so-called future of the internet.

LINUS TECH TIPS YOUTUBE CHANNEL HACKED

World's top tech channel taken down.

Major PC tech YouTube channel *Linus Tech Tips* has been hacked and was unavailable for several hours in late March. From the events that have unfolded, it looks like hackers gained access to the YouTube creator dashboard for various LTT channels. After publishing some scam videos and streams, control of the account was regained by the rightful owners, only to fall again to the hackers.

Hackers who took over the LTT main channel, as well as associated channels such as *Tech Quickie*, *Tech Linked* and perhaps others, were obviously motivated by the opportunity to milk cash from over 15 million subscribers. Among the

spammy videos the hackers quickly started to stream, were promotions for Bitcoin giveaways seemingly backed by the likes of Elon Musk and Tesla.

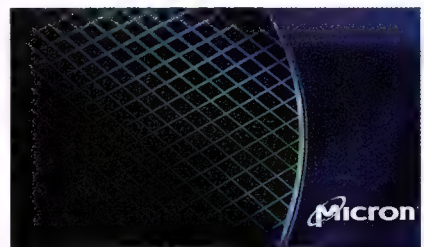


CS:GO SMASHES RECORDS AS COUNTER-STRIKE 2 HYPE MOUNTS

200,000 players over the 2020 lockdown records.

The prospect of *Counter-Strike 2* has a lot of people playing *CS:GO*, with a new all-time peak player record of 1,519,457 being set in late March. That's a number reported by both SteamDB and Steamcharts, and it's wildly higher than *CS:GO*'s prior high water marks. *CS:GO*'s previous high point was in April 2020, when pandemic lockdowns across the world saw many games – and Steam itself – report record player numbers.

That's because *Counter-Strike 2* was announced the same week. It's a real game, it's free, and everything in it carries over from *Counter-Strike: Global Offensive*. Everyone's fancy skins are going to Source Engine 2 land. Yes, even that one person's \$150,000 gun skin. It has sent the CS skin marketplace straight to crazytown.



MICRON LOSES \$3.4 BILLION

Demand for DRAM and 3D NAND nosedives.

For its second quarter of fiscal 2023, Micron posted a year-over-year revenue drop of nearly 53 percent and said its earnings will decline further in the ongoing quarter as demand for 3D NAND and DRAM remains soft. The company had to write down inventory worth billions of dollars, and said it would maintain conservative spending but would have to fire more people than it planned to this year. However, Micron remains confident that demand for memory will skyrocket by 2025 as the world embraces more computing.

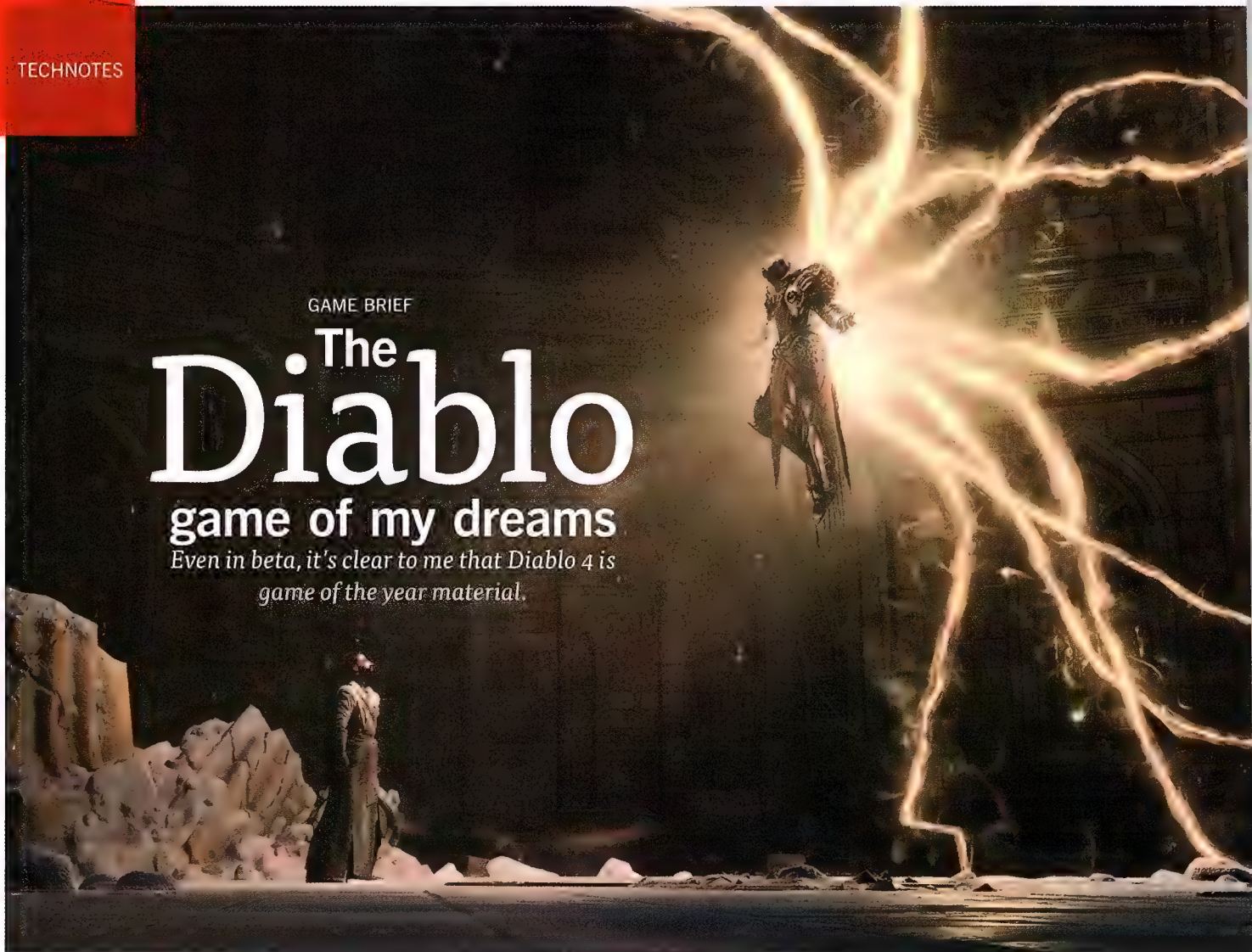
"The semiconductor memory and storage industry is facing its worst downturn in the last 13 years, with an exceptionally weak pricing environment that is significantly impacting our financial performance," said Sanjay Mehrotra, chief executive of Micron. ■

GAME BRIEF

The Diablo

game of my dreams

Even in beta, it's clear to me that Diablo 4 is game of the year material.



The *Diablo 4* early access beta has ended. Thousands of demons have been slain, hundreds of players have been squashed by The Butcher, and many bug reports were filed. While pockets of the internet debate and wade into full-blown arguments over *Diablo 4*'s finer details, as I sit here I am elated.

Diablo 4 was everything I'd hoped it to be, and more. I can't stop thinking about it. I lay awake at the end of Act 1, haunted by the depravity of Sanctuary's denizens, and the hopelessness of existence in *Diablo*'s dark world. I want to live there.

It's true that there are many questions Blizzard still needs to answer. There are many bugs that need to be squished.

Concerns about endgame itemization and even monetization are valid, given some of Blizzard's other recent service games. But, if you want wanton negativity about *Diablo 4*, you won't find it here. Right now, I am basking in the zealous hope that the legendary franchise has returned to a path of greatness.

Getting hooked on an amazing world

Diablo is set in Sanctuary, a magical realm that arose as a result of the eternal conflict between the forces of Heaven and Hell. Unbeknownst to most of its denizens, a union between the angel Inarius and demoness Lilith resulted in

Sanctuary, a realm both hoped to exist beyond the view of the bitter war between the light and dark. Many angels and demons joined them inside this pocket dimension, high on the idea of existence beyond war. The vision was corrupt from the outset, as both Inarius and Lilith twisted Sanctuary for their own ends.

Don't spoil yourself

Without giving too much away (and seriously, if you can: avoid spoilers), *Diablo 4* is a huge step up in storytelling quality and tenacity from Blizzard. Even in the brief glimpse *Diablo 4*'s beta offers, it feels as though Blizzard has well and truly ditched the guardrails in pursuit of the acerbic darkness earlier *Diablo* incarnations represented.

Blizzard is arguably already the best at in the business when it comes to prerendered scenes, from *World of Warcraft* to *Overwatch*, and *Diablo IV* itself. The opening cinematic of Lilith's summoning is among the most impressive visual works ever committed to CGI, and many of these blockbuster-budgeted 3D works will feature within *Diablo IV*. However, they are also expensive, particularly if all you want to do is deliver some quest text, or push the story along.

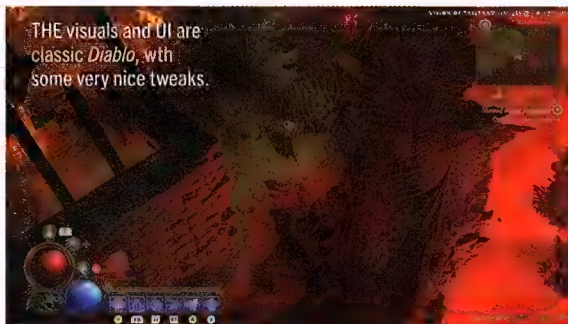
Diablo IV represents a massive leap in intricacy within its 3D models. Every



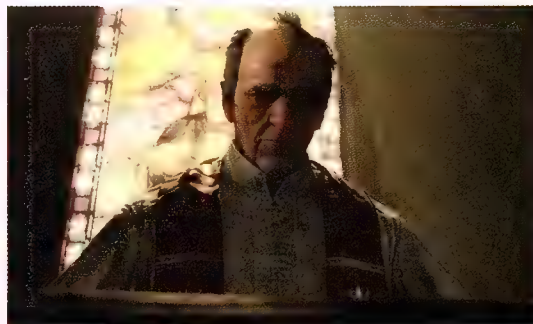


Cinematic cut scenes are a Blizzard forte, and *Diablo IV* looks absolutely epic in that department.

Left: The storytelling is strong in this game, and we strongly recommend you avoid spoilers before playing! (there's no spoilers on these pages!) Above: It's a moody and evocative game world.



THE visuals and UI are classic *Diablo*, with some very nice tweaks.



screenshot I have used in this article was from in-engine, in-game sequences, and not from pre-rendered trailers. The characters are orders of magnitude more emotive and expressive than in some of Blizzard's previous games, allowing for in-game scenes that keep you grounded in the game's world. Your character will perform in these scenes too, and not simply narrate them, making proceedings all the more immersive.

Stellar storytelling

As the player character, you find yourself lost in a blizzard, doomed to freeze in the biting gloom. A mysterious, bloodied hound appears, before setting you forth to a dilapidated hamlet. A mad monk raves, as the townsfolk speak of awakened evil in a tomb to the north. Resolving to aid your shelterers, your fate becomes intertwined with the game's big antagonist, known in legend as Lilith, the Daughter of Hatred.

I am aggressively skirting around the details I really want to share because I want anyone and everybody reading this to experience it for themselves firsthand. There's a deep sense of foreboding in every word delivered in *Diablo IV*, with each character class and gender having a unique and fully voiced dialogue. Your character appears alongside major heroes and story figures within these scenes, anchoring you into the dark world that is

Sanctuary. I feel invested in *Diablo IV* in a way that simply hasn't been possible in similar fixed-camera action or even tactical RPGs as a result, and I hope it will be a watershed moment for the genre.

Oftentimes I feel like the larger publishers rarely stray from "safe" storytelling devices. The few times they have strayed, it isn't always elegant in execution. *Diablo IV* is delivered with a level of unapologetic conviction reminiscent of the strange cults and sects that dwell across Sanctuary. Depraved, twisted, blasphemous. I love it.

A sublime slaughterhouse with stunning scenery

In the beta, we had access to barbarians, rogues, and sorcerers, giving a pretty broad spectrum of playstyles to pick from. Each of these classes could be specialised further, vastly altering how they play in practice too. As a rogue, you could focus on dagger combat, or ditch the blades for crossbow bolts and traps. You can even build out combinations of both playstyles, with a hotbar of six skill slots to customise to your content. I dabbled with various types of gameplay before settling on the sorcerer, primarily wielding shattering ice spells that cause

enemies to explode into broken shards of frozen meat. The chilling effects also helped out my groups, slowing enemies down or freezing them in place for others to land critical blows.

Diablo has always revolved around obliterating scores of demonic beasts in waves of explosive attacks. *Diablo IV* is a big step up in terms of visual feel, taking advantage of modern systems with spectacular lighting, satisfying physics, and dynamic destruction that lends weight and power to your attacks.

"Diablo 4 is a huge step up in storytelling quality and tenacity from Blizzard."

Even though I have some concerns about dungeon variety, boss dynamism, and endgame progression systems, I remain optimistic. We simply don't know how a lot of these features and systems will play out. Call it hopium, but I'm eager to give Blizzard the benefit of the doubt following the recent successes of *Diablo II: Resurrected* and *World of Warcraft: Dragonflight*.

If Blizzard can build an entire game with this level of evocative storytelling, and compelling combat, wrapped in an ongoing service that me and my friends can play for hundreds of hours – it's not hard to imagine *Diablo IV* taking home many game of the year awards later this year as people discover its magic.

Jez Corden ■

END USER

It's OK to feel anxious about AI, but it could be amazing for videogames

With the right amount of restraint, AI could help realise living game worlds we've only previously dreamed of, writes Shaun Prescott.



Shaun is an Australian editor for *PC Gamer*, *GamesRadar* and *PLAY*, and writes for *APC*, *TechRadar* and more.

Millions of people are rightfully anxious about the new artificial intelligence era, which seems to have ambushed us in the last five months. According to Goldman Sachs economists, a whopping 18 percent of existing jobs could be replaced with AI, including the likes of lawyers and (groan) writers.

Like most new burgeoning paradigm shifts, it's understandable to feel anxiety and amazement in equal measure. I myself am slap bang in the middle at present: there are

myriad factors to take into consideration, and many that are yet to occur to us. Stymied by this onslaught of ambiguity, I can't help but to take

"I can't help but to take refuge in a tunnel vision view of AI"

refuge in a tunnel vision view of AI. And lately that tunnel has led me to the conclusion: AI is gonna be great for videogames.

Hear me out: I'm not talking about AI-generated graphical assets, advanced procgen world building, or anything like that. The dream was sparked by a recent Ubisoft announcement, which described new internal AI tech allowing developers to generate "NPC barks" with AI. In other words, in Ubisoft's open

world games, the inconsequential utterances of characters populating say, an urban open world, aren't written by writers per se, but by the machine. Critically (for Ubisoft's PR department, perhaps) the technology still requires the input of real human developers.

This tech was apparently written at the request of Ubisoft writers themselves – a clarification made following backlash along the usual lines. But it's fairly easy to take this fairly barebones concept and run with it, if only to dream.

One of the most common criticisms of massive, open world videogames is their dearth of interactivity. Sure, there are a lot of so-called characters moping about, but what do they have to say for themselves? Very little, usually, and even concerted efforts to change that – see *Red Dead Redemption 2* – are shallow, simply because there are not enough hours in the life of a thousand-strong development team to substantiate, humanise, a make-believe population.

Now imagine if every character in, say, *Skyrim*, could be conversed with at length, forever. The main questline, the main story beats, would still be written entirely by humans. But when it comes to

NPC interactions, imagine if game writers could simply shape the parameters of a single character's personality and knowledge-range, and then allow players to chat, learn, negotiate with those characters, in a similar way as we do with ChatGPT? In some ways it's not at all dissimilar to what Ubisoft is already doing, only on a much larger scale.

There would probably be more labour involved in this than in simply writing a half-dozen perfunctory lines for each inconsequential game character. The labour would involve, as above, shaping the parameters of the conversations, guiding a character's temperament, etc. But it would likely result in a much more lifelike virtual world, and frankly, I'm surprised some enterprising studio hasn't already promised it's going to do so.

Could AI's encroachment on the arts and other creative industries be chaperoned towards a more supplemental effect, rather than wholesale replacing it? Mass culture will almost certainly be flooded with AI in the coming years. Anything without the profit motive front-of-mind, will probably resist. But in these early days of anxiety and excitement, the view is still clear enough to imagine appealing compromises.

■ **Shaun Prescott**



Microsoft's 365 Copilot is about to do the job of most office clerks

AI that can write reports, rank emails and summarise data is about to be integrated into the world's most popular office apps and we're not sure everyone is ready for it.

If you'd asked us a few years ago which jobs were first in the firing line for AI automation, we would have probably answered that delivery drivers, factory workers and other jobs with lots of easily automated physical tasks were likely to be the hardest hit by the AI revolution. Ask us that today, and we'd say the future is looking pretty dire for administrative staff, office clerks, technical writers and well basically anyone who spends time in Word, Excel, Powerpoint or Notes documents.

On March 17th Microsoft announced its intent to release a new Large Language Model (LLM) AI called Copilot to its Office 365 suite of cloud based productivity apps, a prospect that is both exciting and terrifying. We've actually covered ChatGPT in our last two Random Access columns, a milestone that makes this AI development perhaps more significant than any other tech story we can think of in the last few years. In APC 517 we covered just how powerful ChatGPT was and how it was already creating chaos in educational and journalistic spheres and in APC 518 we

explored how it will change the way we search for things on the web (and even potentially which search engine we use to do so). This month we're going to take a look at how Microsoft is adding AI functionality to its office software – a move that will make it so easy to use that it's now virtually impossible to imagine a world without huge amounts of AI-written content.

The Microsoft 365 Copilot presentation showed the Copilot

software autonomously drafting a written proposal in Word using a Notes file created by a

user and then reformatting it into the style of another previously-written Word document. From here, the presenter asks it to add pictures and subheadings and then even write a summary blurb at the top of the report. In other parts of the presentation Copilot is tasked with writing a PowerPoint presentation from the previously created document using a single written command and it spits out a well formatted 10-page presentation in just a few moments.

It's not just written responses

either, it can summarise data sheets to pull out the most prominent trends, scan your emails and show them to you in order of importance, or summarise the key points of a Teams meeting if you arrive late so you're up to speed in real-time. There were so many game-changing developments in the new Copilot powered Microsoft 365 suite presentation that it feels like the space jumped forward decade in just a few months.

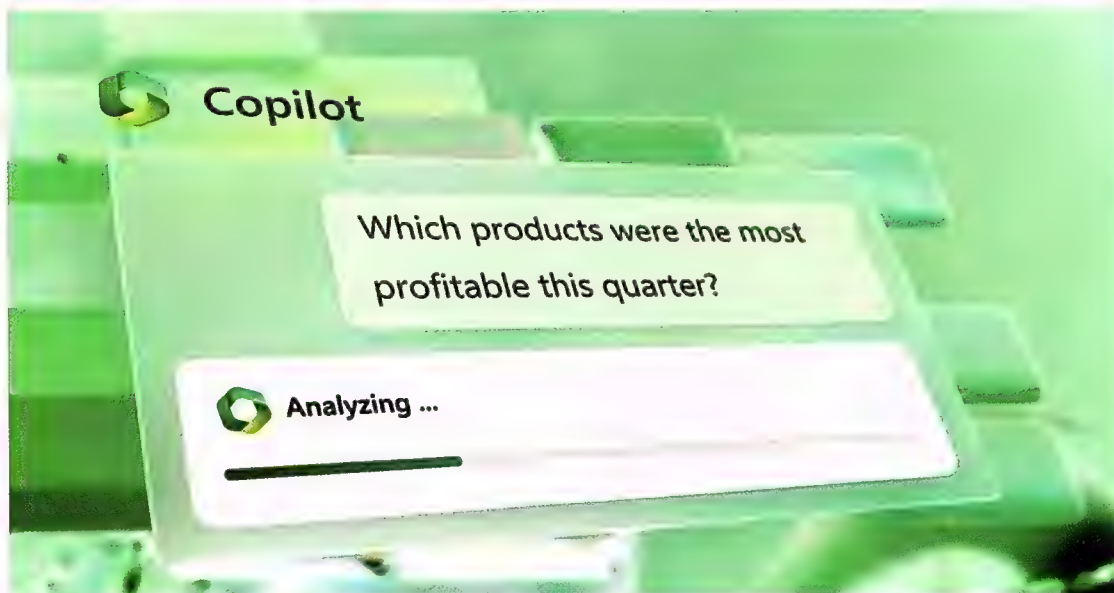
While the marketing videos are full of optimism and productivity promises there's a complicated side to this level of progress too. For anyone who regularly writes reports, summarises data or spends time building presentations they're going to need to upskill quickly 'cause AI can now do it 80 percent as well in a fraction of the time. The amount of time these features can save companies is going to be enormous and post-Covid businesses in the current economic climate will begin looking to products like Microsoft 365 Copilot as a way to cut large portions of administrative staff to save costs.

At least AI is also supposedly a pretty good therapist, for anyone who might lose their job to it.

Joel Burgess



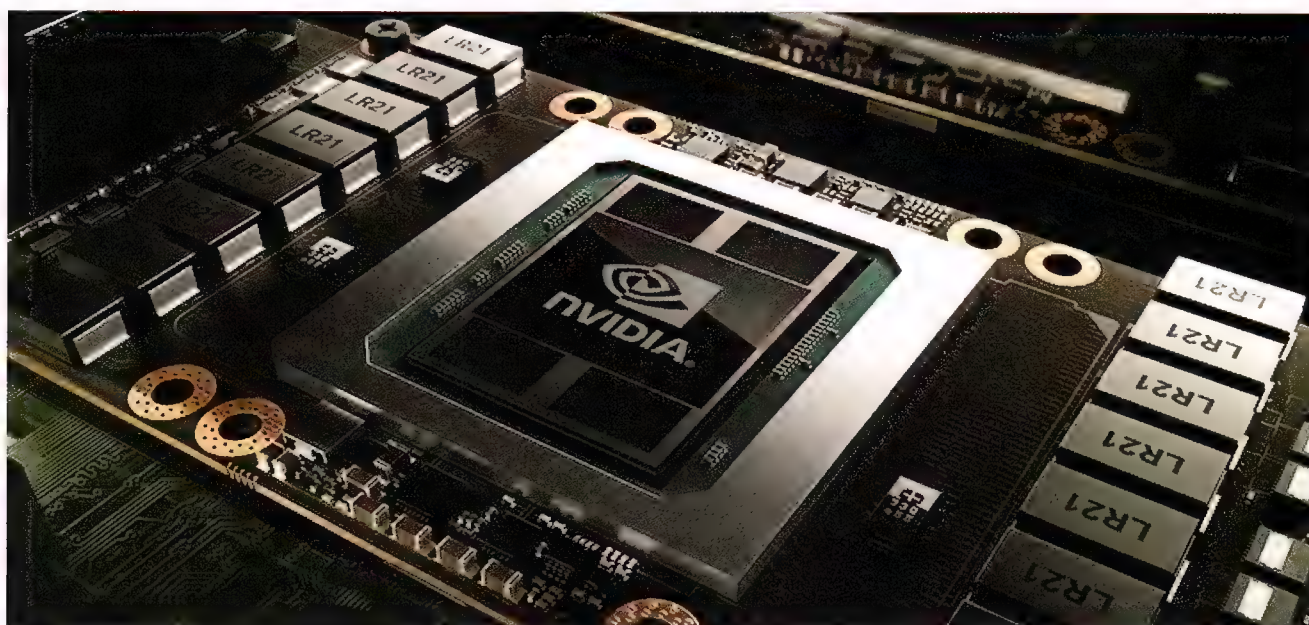
Joel is one of the senior journalists on APC magazine and apart from being the resident laptop, monitor and fitness tech geek, he's also pretty into surfing his local Sydney beach breaks when he's not in front of a screen.



TWO BITS

Nvidia says crypto is 'not useful for society'

AI is where the real money is.



Chris has been elbow deep in PCs since before the turn of the millennium, and he wouldn't have it any other way.

Do you remember the days when GPUs were for playing games? Boffins long ago realised that GPUs were also incredibly good at parallel processing. With the right software, GPUs and their computational power can do all sorts of wondrous things. Think simulations, modelling, rendering and encoding. Then there's crypto mining and the latest buzzword: Artificial Intelligence.

Nvidia has seen an explosion in revenue over recent years. It's always been the biggest name in

“Cryptocurrency doesn't “bring anything useful for society.”. This comment is inaccurate in my opinion.”

gaming graphics. Its professional Quadro cards attracted high margins and its CUDA ecosystem continues to see year-on-year growth. And then graphics cards became popular for

cryptocurrency mining, specifically Ethereum. Anyone looking to buy a GPU for gaming over the last few years would have been aware of how stocks of gaming graphics cards all but dried up, instead being sold to miners.

Now that Ethereum has moved to a Proof of Stake consensus mechanism, gaming graphics cards

are widely available again. Most of the major cryptos use PoS or specialised ASICs, as is the case with Bitcoin. With its gravy train gone, Nvidia has pivoted away from the crypto market – and the negative market perception of it. It's hitching its wagon to AI applications.

According to Nvidia CTO Michael Kagan via an interview with The Guardian, cryptocurrency doesn't “bring anything useful for society.”. This comment is inaccurate in my opinion. Cryptos, and perhaps more importantly the blockchain technology that underpins them, offer a lot of societal benefits, both economically and as immutable ledgers, but sadly the public perception of cryptos and their benefits gets lost as continual news of scams adds to public distrust.

Cryptos and AI are two wildly different applications. The arguments for and against cryptos and blockchains could take up this entire issue of APC, but if there's one thing that everyone can agree on, it's that AI is a big deal, and it's only going to get bigger.

Kagan went on to talk about the rise of chatbots, with ChatGPT in particular getting a lot of attention for its scarily impressive abilities. And even scarier is that AI has a massive potential upside. Nvidia is all too happy to sell very expensive

GPUs to companies looking to develop AI technology. The Google's, Amazon's and Microsoft's of the world have an insatiable appetite for processing power. Nvidia is well placed to make an absolute mountain of cash in the years to come.

Nvidia is developing software libraries, quantum technologies and GPU based processors to accelerate deep learning and AI applications. It's a big business. In fact, at the time of writing, Nvidia was the 8th largest company in the world by market cap. It has the potential to head higher on that list.

If you have any doubt as to why Intel developed Arc graphics cards, it wasn't about gamers. It too knows that crypto isn't the future of GPGPU processing. It's AI, big data and contracts worth multi millions of dollars.

So, while Proof of Work mining with GPUs is almost certainly a thing of the past, the Nvidia CTO's comments about crypto are perhaps influenced by his company's business priorities, and less so by what they can actually bring to society. They are two completely different applications and both can co-exist. Nvidia is simply pivoting away from the collapsed mining market to one it can make money from, with even more potential.

■ Chris Szewczyk

The meteoric rise of ChatGPT

In the beginning, we were impressed. Now we just want to keep our jobs.

Deep learning, artificial intelligence, and large language models (LLMs) aren't entirely new – we've been hearing about them for years in various forms. But 2023 could mark the tipping point where things truly go mainstream, after a company called OpenAI shook the foundations of multiple industries by releasing its ChatGPT tool to the public.

Earlier this year, OpenAI previewed and then eventually provided public access to its text-to-image Dall-E 2 tool. To say that people have taken note would be an understatement. In just two months since its launch, ChatGPT has reached over 100 million users. That's the fastest ramp in users of any internet app, with TikTok coming in second at nine months, while Instagram required two and a half years to reach that number. People are asking it for advice, letting it write essays and poetry, asking it to tell jokes, and attempting to play text-based games (though it cheats at Hangman).

In February, Microsoft announced an updated version of its Bing search engine, with a customised ChatGPT-powered 'chat' function codenamed Sydney and Google revealed its rival Apprentice Bard AI. Where Microsoft opened the doors to public access, Bard isn't available to the public. Given what we've seen from Bing, though, that might be for the best.

Bing Chat perhaps had too much personality, expressing emotions including love, anger, and insecurity. Cue the "I've been a good Bing Chat. You've been a bad user" memes – yes, it actually used that line. Microsoft apparently didn't learn the lessons from its aborted Tay chatbot, but was

"We're not yet at the point where you can run your own ChatGPT instance, as the model requires around 800GB of memory."



quick to nix some of Sydney's behaviour – I'd argue that it was more entertaining when it had emotions.

The problems with ChatGPT, Bing Chat, and similar tools aren't limited to personality, however. Asking ChatGPT for advice on how to build a PC yields some seemingly reasonable advice, except it clearly lacks experience in building PCs and instead spits out a step-by-step guide that is likely to result in a non-functional system and potentially broken or incompatible parts. ChatGPT notes that it can provide factually wrong information, but only someone educated in a topic is likely to notice.

But ChatGPT and similar tools aren't going away. The current version is GPT-3, a third-gen 'Generative Pre-trained Transformer', but GPT-4 is already in development, which should provide improved results and performance on a similar data set to GPT-3. There's a race

to see who can successfully deploy LLMs and capture more of a potentially lucrative market.

We're not yet at the point where you can run your own ChatGPT instance, as the model requires around 800GB of memory. That's a big jump from the 4-8GB needed to run Stable Diffusion, an open-source AI tool for generating images from text descriptions. But with free public access to ChatGPT and Bing Chat, that may not matter.

Thankfully, other tools are being created to combat the use of ChatGPT. That's good news for educators, who might otherwise be hard-pressed to determine whether students are doing their homework or leveraging an AI. GPTZero.me can help determine the likelihood of something having been generated by ChatGPT. This article checks out as "most likely human written", which is good, as it means I'm not yet out of a job.

Jarrod Walton ■

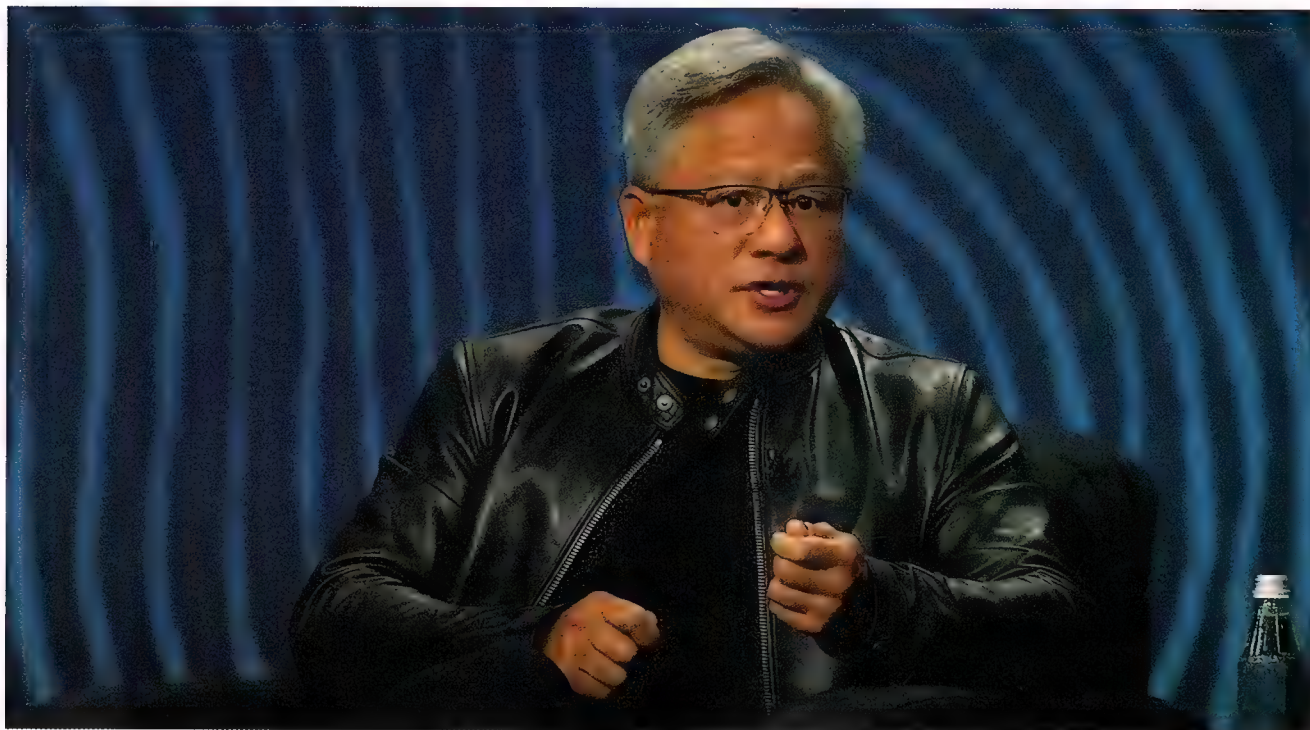


Jarrod Walton
Jarrod has been described as an AI by people he meets at parties.

TRADE CHAT

Our big green friend

It hurts to admit it, but Nvidia is good for the PC.



Jeremy Laird
Has a black leather jacket just like Jensen's.

How much longer will this ludicrous graphics card pricing last? I believe that an adjustment will happen, eventually, but is Nvidia to blame and do silly GPU prices prove that the company is a malign influence? The answers to those questions are yes and, surprisingly, no. The company is no angel. But the PC is still better off with Nvidia.

Here's the thing. Nvidia is pathologically pushy, for better and for worse. The same mindset that drives the company forward with aggressive, relentless innovation is also at the root of Nvidia's occasionally questionable commercial policies and prickly interactions with outside observers.

Take DLSS, or Deep Learning Super Sampling. When it was first mooted back in 2018, it looked like tech straight out of the classic Nvidia playbook – proprietary, superficially seductive but, ultimately, of dubious real-world value. Except, DLSS has evolved into a fantastic technology and has made upscaling an essential part of the GPU feature set. And with DLSS 3 and its clever frame generation,

Nvidia has moved the game on further. Its main rival AMD is in constant catch-up mode.

Then there's ray tracing. When the first ray-tracing-enabled GPUs debuted with the RTX 20 series, it looked like another questionable technology locked down to Nvidia hardware and barely relevant to actual gaming. Hardly any titles supported it, those that did barely used it, the performance was terrible and you were doing well to spot the difference it made to rendering quality.

But three generations of RTX GPUs on, AMD and Intel are fully committed to ray tracing. While it still doesn't make a huge difference to the way games look, few doubt that ray tracing will replace rasterisation as the dominant technique for rendering lighting in 3D game engines. More to the point, without Nvidia as a driving force, ray tracing would barely be a thing at all on the PC.

There is of course the other hand, the shadier and more malign yin to Nvidia's innovation yang. Over the years, Nvidia's influence over game development, its attempts to align game engines

with its own hardware rather than targeting the best performance and quality regardless of GPU vendor choice, has arguably been to the detriment of the PC as a whole.

Then there's the way Nvidia has sandbagged certain GPU generations, especially when the AMD competition failed to turn up. How much faster would PC graphics be if Nvidia made the best products possible rather than the minimum needed to maintain its performance advantage?

The less said about the way Nvidia throws its toys about when a media outlet dares to contradict its favoured narrative the better. Banning YouTube channels from its review cycle isn't a good look.

Right now, product pricing is admittedly making it hard to remember all the good things that Nvidia has done for PC graphics. But as offensive as an RTX 4080 graphics card from Nvidia is for \$2,200, and as frustrating as it is to know how good its latest RTX 40 generation of GPUs could be in general if only they were priced sensibly, the positives Nvidia has brought to PC gaming over the years still far outweigh the negatives.

Jeremy Laird ■

ONE MORE THING

cR@ckH3@d5

Jon Honeyball asks you to do one more thing for him.



We need to talk about passwords. I know they're boring, they get in the way, and surely something is just around the corner that will cast them into the dim recesses of computing history? I hate to disappoint you, dear reader, but passwords will be around for a long time. Which makes it all the more essential that you're on top of them.

There are numerous ways that passwords can be broken, from sheer brute force attacks through to social engineering stings and dictionary attacks.

There's another category, of course, which we could call laziness, stupidity or ostrich (as in, it won't happen to me). Just do a web search for "most common passwords 2022" and the list will make you quite depressed. According to NordPass, makers of the well-known VPN provider NordVPN, the number one entry is "password". Followed by "123456". Then "123456789", as if this is going to be more secure than its shorter brother.

At this point, you should be wondering to yourself how easy is it to check the strength of your own password. Well, the good folks at Bitwarden have a free checking tool at bitwarden.com/password-strength. It's safe to

use to check your super-secret password, because it isn't transmitted to Bitwarden for checking. All the work is done locally using a tool called "zxcvbn", which runs in your browser session.

Now, it's important to remember that estimates about the strength of a password will use a number of assumptions. No single tool will be perfect. Based on my own experiments, adding in a mix of upper and lower case letters makes the password stronger, but it's best if the letters aren't in the usual capitalisation points. Numbers and other symbols help considerably.

But at the end of the day, it has to be something that you will remember, and that you can build up muscle memory to type quickly and accurately. If someone is watching over your shoulder, or there is a high-quality security camera watching your keyboard, then speed is a help here too.

So given the caveats, it is worth considering how quickly the Bitwarden password checker things a given password can be broken. It rated "Coles" as very weak, with an estimated crack time of two seconds.

"ColesFinest" is good at five hours, "ColesFinestFood" strong

at two years. Bitwarden gave "ColesFinestFood" a 13-year life, while "ColesFinestFood" (where I replaced the number 1 with a capital "I") adds another 55 years. How long, you ask, for "The Cat Sat On The Mat"? That earns an estimated time of "centuries".

And no, before you ask, none of these passwords are used by me. Although my master password is rated as "1,000+ centuries" too.

Given that these tools exist, it's obvious that you really should check out the master passwords that you use. In no way does this remove the need for 2FA, nor for hardware encryption keys for the most sensitive data. Having that third level of defence is critical, especially if you are the target of a sting operation. But given how easy it is to check, and how it takes a few seconds, only the truly mad would ignore a simple check.

After all, You d1nt wAnt youR PasswordZ 2 b% EaZy To GeZZ.

Jon Honeyball ■



Jon Honeyball
Jon Honeyball's
crypto is \$tR0nG_.

"At the end of the day, it has to be something that you will remember, and that you can build up muscle memory to type quickly and accurately."

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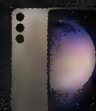
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FLEXIBLE BRILLIANCE

This is a brilliantly made 2-in-1 that's flexible both in design and configuration. Everything screams quality, from the wide-gamut 13.3in matte screen to the enhanced features for Zoom calls – including a superb 1080p webcam, mics and speakers. \$5,031, dell.com/en-au



ALTERNATIVES

DELL XPS 15 (2022)

Surely the best Windows all-rounder money can buy, with a slim design, gaming potential and plenty of power courtesy of Intel's 12th gen Core processors. From \$2,924, dell.com

APPLE MACBOOK AIR

The MacBook Air M2 looks like a standout to us. A powerful and quiet ultraportable with an unbeatable battery life and a great pro display. From \$1,899, apple.com/au

MICROSOFT SURFACE PRO 9

APC rates the Intel model highly, the SQ3 model less so. With Intel, you get a solid upgrade to the world's leading detachable tablet laptop. \$2,549, microsoft.com

ALTERNATIVES

■ NEW ENTRY

LENOVO THINKPAD T14 GEN 3 (INTEL)

An awesome keyboard, slim design, customisable spec and fine selection of ports make this a great business laptop. \$2,529, lenovo.com/au

■ NEW ENTRY

ACER TRAVELMATE P6

Not the most powerful due its 11th gen Core chip, but a great 14in screen and keyboard, superb battery life and competitive price lift it above rivals. \$2,799, acer.com

■ NEW ENTRY

DYNABOOK PORTÉGE X40L-K-101

A simply brilliant 1kg 14in laptop that excels in all areas, including superb battery life. Buy the K-105 for \$2,193 if you can live with a Core i5 processor. \$2,543, anz.dynabook.com

GAMING LAPTOPS

RAZER BLADE 15 (2022)

A SUPERBLY ENGINEERED GAMING POWERHOUSE

Right now there's just not another better gaming unit around. It's miraculously thin considering the beefy components inside, thermals are very well managed and the Razer Blade 15 manages to extract very good performance from its GPU without undue throttling. There are many variants and options, and they're an outstanding buy if you find one on sale. ~\$4,499, razer.com/au-en



EVERYDAY LAPTOPS

MICROSOFT SURFACE LAPTOP GO 2

FEELS LIKE A PREMIUM ULTRABOOK, BUT COSTS HALF AS MUCH.

A solid update to an amazingly good value mid range ultrabook. It runs cool and quiet, and has up to 30 percent better battery performance than its predecessor, all in a beautifully designed form with a superb keyboard and trackpad. From \$1,099, microsoft.com/en-au



ALTERNATIVES

LENOVO LEGION 5I PRO (16IN)

A great-value gaming laptop that's extracts the most from its powerful components. We really love the keyboard, too. From \$2,649, lenovo.com/au

AORUS 17

If you're after a device to seriously game on, and you don't care about the bells and whistles then this is a great option that cuts costs in all the right places. \$3,699, gigabyte.com

ASUS ROG ZEPHYRUS G14 (2022)

A powerful gaming ultraportable that lights up for both work and play. The AMD CPU and GPU balance well. \$3,99, asus.com/au

ALTERNATIVES

LENOVO YOGA SLIM 7 PRO

A powerful, well designed ultrabook with an awesome OLED screen for a good price. The original 2-in-1 bends into a new clamshell shape. \$1,699, lenovo.com

HP ENVY 13 (2020)

It may not be the world's most exciting laptop, but the Envy 13 is a compact and forward-looking machine that's ideally suited to these homeworking times. \$1,699, store.hp.com

HP PAVILION 14

This slim 1.4kg laptop is a superb choice for anyone on a tighter budget. It struck an excellent balance between speed and battery life – around ten hours. From \$999, store.hp.com

CHROMEBOOKS

ASUS CHROMEBOOK FLIP CX5

The best big-screen Chromebook we've tried, with a bright 15.6in Full HD display with decent black levels and surprisingly rich colours. And it's a good specification for the price, with a Core i3 processor, 8GB of RAM and a 128GB SSD in tow. \$1,213, [asus.com/au](https://www.asus.com/au)



LENOVO FLEX 3 CHROMEBOOK

This isn't the most powerful Chromebook, but students need reliability more than power – especially if they're only really using it for homework, note-taking, and perhaps the occasional bit of Netflix. \$484, [lenovo.com/au](https://www.lenovo.com/au)

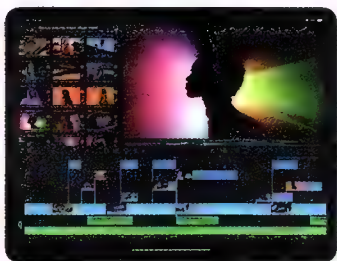
LENOVO IDEAPAD DUET

The Chromebook answer to Microsoft's Surface tablets, this is a seriously versatile device – albeit not the speediest (although we never found it to be painfully slow while carrying out everyday tasks). For this price, and with a 16hrs 14mins battery life, the Duet is a great choice. \$899, [lenovo.com/au](https://www.lenovo.com/au)

TABLETS

APPLE IPAD PRO 12.9IN (2021)

M1 POWER IN YOUR PALM FROM \$1,199
Blurring the boundaries between laptop and tablet like never before, the M1-powered iPad Pro 12.9-inch is every bit as fast as we expected – and the "Liquid Retina XDR" display is simply phenomenal. From \$1,649, [apple.com/au](https://www.apple.com/au)



APPLE IPAD (2021)

Apple performs its usual trick of upgrading just enough to keep the iPad affordable and up to date, without treading on the toes of its more luxurious stablemates. The big bezels remain, but a faster processor, more storage and improved camera all add to its appeal. From \$499, [apple.com/au](https://www.apple.com/au)

SAMSUNG GALAXY S8 ULTRA

The Samsung Galaxy Tab S8 Ultra is an enormously impressive tablet. It makes a fantastic first impression with its gorgeous screen and thin body, and is great for multitasking. If you want the best Android tablet going, there's no question at all that this is it. \$1,499, [samsung.com](https://www.samsung.com)

EVERYDAY MONITORS

PHILIPS BRILLIANCE 346P1C

34-INCH CURVED DOCKING, No-one can match Philips for its mix of quality, features and value, especially when it comes to curved MVA monitors such as this. It's great for casual gamers and busy workers alike, with USB-C docking and superb colours. \$849, [philips.com.au](https://www.philips.com.au)



EIZO FLEXSCAN EV2480

Businesses in particular will love this easy-to-roll-out 24-inch monitor, with its exceptional five-year warranty, USB-C port for easy docking, excellent viewing angles and delicious whites. And it has the best OSD around. \$699, [eizoglobal.com](https://www.eizoglobal.com)

DAHUA DHI-LM28-F420

This affordable 4K monitor might not offer much in the way of menu options or high-end gaming perks, but it offers impressive resolution and colour for ally pay. \$269, [dahuaaustralia.com.au](https://www.dahuaaustralia.com.au)

PROFESSIONAL MONITORS

EIZO COLOREDGE CG319X

CREATIVE MASTERCLASS, \$7,119
As the price indicates, this monitor is for heavyweight creatives who demand the best in every discipline: HDR video editing, print layouts, professional photography and more besides. With superb coverage and accuracy across all spaces, plus a built-in calibrator, it justifies the investment. \$7,119, [eizoglobal.com](https://www.eizoglobal.com)



BENQ PD2725U

By no means a cheap 4K 27-inch monitor – unless you compare it to the Eizos – but it marries all-round quality with ease of use thanks to a puck that allows you to quickly move between settings. You can even daisy chain a second Thunderbolt 3 monitor for a monster setup. \$1,799, [benq.com](https://www.benq.com)

EIZO COLOREDGE CG279X

Designers who need to work across different disciplines will love how easy it is to switch between the Adobe RGB, DCI-P3 and sRGB colour spaces using the Eizo's fantastic OSD. It's certainly not cheap for a 27-inch 1440p monitor, but it's packed with quality. \$3,095, [eizoglobal.com](https://www.eizoglobal.com)

HOME OFFICE PRINTERS

EPSON ECOTANK ET-1810

BACK TO BASICS
There's nothing flashy about this bottle-fed inkjet: it's there to churn out pages at a decent rate (8.8ppm for black text) for a low price. It comes with enough ink for 4,500 black pages and 7,500 in colour, but refills are cheap. Just don't expect features like duplex printing. \$299, [epson.com.au](https://www.epson.com.au)



CANON PIXMA PRO-200

Yes, it's big and it's expensive – and you don't even get a scanner – but the Pixma Pro-200 means that you can print A3 photos with glorious colour accuracy and detail. If you're after an office workhorse, look elsewhere, but it can't be beaten on photo quality. \$809, [canon.com](https://www.canon.com)

BROTHER MFC-J4540DWXL

Home workers will love this inkjet all-in-one. It combines an incredible range of features with all the connectivity you need and extreme ease of use. Output quality is fine, it offers the best cloud support around and the high-capacity ink pack could keep you going for years. \$420, [brother.com](https://www.brother.com)

WIRELESS ROUTERS

SYNOLOGY WRX560

THE PERFECT ROUTER

Its quad-band Wi-Fi smashed-through our performance tests managing 791.5Mbps up close, 375Mbps two rooms away and an amazing 216.7Mbps down the garden.. \$599, synology.com/au



■ NEW ENTRY

ASUS ROG RAPTURE GT-AX16000

The most splendid, overpowered router on the market. But, it's silly money and aspirational to most users. Ultimately, though, it's currently the highest-spec consumer router available. \$1,299, asus.com/au

SYNOLOGY RT6600AX

Fast, well-featured and secure, the Synology RT6600ax is as perfect for professionals and prosumers as much as it is for SMBs and smart homes, and the app and interface are a delight to use for both experts and plug and play users alike. \$599, synology.com/au

MESH WI-FI

TP-LINK DECO XE75 AXE5400

SUPERB WI-FI 6 MESH

Offers the simplicity, speed and range most people want from a mesh system. While it's expensive, nothing else offers the plug-and-play simplicity, speed and range afforded by the Deco XE75. \$999, tp-link.com



TP-LINK DECO X20

The price below isn't a typo: the Deco X20 makes it possible to upgrade your home network to Wi-Fi 6 – as well as manage its security – for the price of some standalone routers. The included HomeCare functions are also a great bonus for households where lots of devices are fighting over the bandwidth. \$199, tp-link.com

ASUS ZENWIFI AX

The interface and design certainly aren't the prettiest (the nodes look like mini space heaters, while the charcoal version is straight out of the 1980s), but if you're after strong performance, great features and plenty of expansion potential, the ZenWiFi AX is a compelling prospect. \$949, asus.com/au

NAS SERVERS

QNAP TS-130

SIMPLE HOME NAS

An above average CPU and RAM combo, solid features and affordable price make the QNAP TS-130 worth considering. Alternatively there's the two bay TS230 which features the same CPU, with 2GB of RAM, dual drive bays, and an extra USB port on the front for a modest \$50 price increase. \$250, qnap.com



ASUSTOR NIMBUSTOR AS5304T

This is a hugely powerful four-bay NAS that will be overkill for most people – not just due to its speed but also its slightly intimidating user interface – but techies and gamers should investigate the Nimbustor AS5304T for both its speed and flexibility. \$799, asustor.com

SYNOLOGY DISKSTATION DS1522+

At \$1,199 it's not cheap but factoring in the software means it's great value. Though some internal silicon may lack headroom, this is still a well-featured, expandable NAS with fantastic software. The best part is the DSM software. \$1,199, synology.com

SECURITY SOFTWARE

■ NEW ENTRY

G DATA TOTAL SECURITY

A suite for power users with a host of useful features that offers formidable protection against viruses. US\$49.95, 1 device, gdatasoftware.com



ALTERNATIVES

■ NEW ENTRY

AVAST ONE ESSENTIAL

The only product in our tests to score a 100% protection rating for blocking all malicious files, this reliable choice is our pick of the free AV tools and includes a free if limited VPN service.. Free, avast.com

■ NEW ENTRY

MCAFFEE+ ADVANCED

A high-end choice with high-end features and support for an unlimited number of devices. Good value for the first year, but watch out for renewals. \$139.95, individual, unlimited devices, mcafee.com/en-au

VPNs

NORDVPN

NordVPN provides consistent and fast speeds, serious security, great support for video-streaming services and some cost-effective subscription rates. \$59 per year, nordvpn.com



ALTERNATIVES

PROTONVPN

ProtonVPN provided one of the best free offerings of all the VPNs in our group test, including unlimited data, but upgrade to benefit from even faster speeds and many more options. Free, protonvpn.com

SURFSHARK

A strong rival to NordVPN, especially if you're willing to commit to its two-year contract. It's fast, cheap and a fine choice for people who like to switch to US streaming services. \$66.34 for one year, surfshark.com

PASSWORD MANAGERS

BITWARDEN

Bitwarden has a huge advantage: it's free. It isn't as slick as some paid-for rivals, but it can sync passwords across all devices for no extra charge. Free, bitwarden.com



ALTERNATIVES

DASHLANE

A manager that's ideal for beginners, and it even builds in an unlimited (if basic) VPN service. Note you may prefer to buy the Family plan (\$60 per year) as this extends the service to six people. \$55.99 per year (Premium), dashlane.com

1PASSWORD

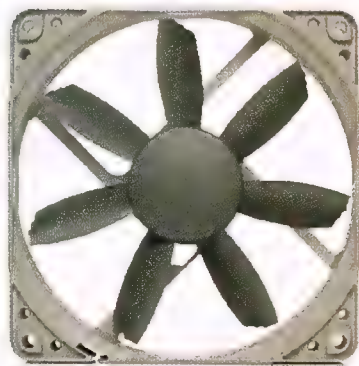
1Password is targeted at technically minded users who are looking for the last word in security. It even offers a Travel Mode that may ease your mind if surrendering your phone to customs officials. \$54.99 per year (individual), 1password.com

THE LIST

The top five PC fans

When building a rig, it can be tempting to use your case fans and leave it at that. But if you're maxing out your graphics card and CPU, it pays to spend a little more attention on the airflow.

Cool hardware is essential for optimal PC use and good PC fans are so important we often recommend checking the fans first in the event of any issues. So, if you want the best fans for your PC, we've listed five of our favourite options below.

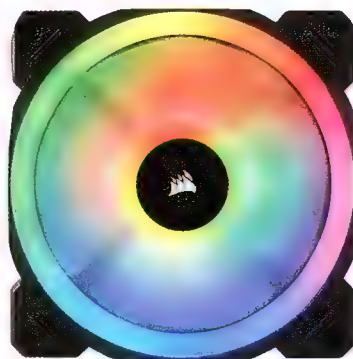


1

NOCTUA NF-S12B REDUX-1200

www.noctua.at, \$35

If you care about case fans, you'll already know the name Noctua. The company's Redux line upgrades the old brown coloured units with a modern grey-and-black look that won't detract from the rest of your PC build. It's not as quiet or efficient as another blacked-out model, the NF-S12A, but it is cheaper. The NF-S12B Redux-1200 balances great performance with a budget-friendly price tag – and it looks great too.



2

CORSAIR LL120 RGB

www.corsair.com, \$39

If you're after that cyberpunk aesthetic, Corsair's LL120 Pro RGB fans are the best around. They're the brightest fans we tested and a perfect fit for any RGB addict. At mid-range speeds, they're slightly louder than the competition but, at load, they're quieter than just about any non-Noctua fan we tested. They're expensive though, with a pack of three costing \$140.

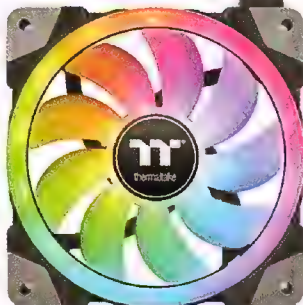


3

NOCTUA NF-A12X25 PWM

www.noctua.at \$59

If you're a PC hardware enthusiast, you'll respect anyone who uses Noctua's khaki-and-mud colored components, even if they do give your build something of a retro look. On the plus side, this fan is the quietest we tested and it also pumped the most air through our test rig. The price is high but the performance is magical, meaning it's the best pick for those who want to push their fans hard.



4

THERMALTAKE SWAFAN EX12

www.thermaltake.com.au, \$189 (three pack)

This brand new product has a unique feature. Sold in kits of three fans, each connects magnetically to another, and the array of up to three are then connected to the PC via a single cable. That makes it potentially tidy for front mounting, or perhaps to replace stock AIO fans. They also have swappable fan blades, allowing you to reverse the direction of flow without affecting the aesthetics.



5

NZXT AER RGB 2 120MM

www.nzxt.com, \$33

Nzxt makes gorgeous hardware – not always the cheapest or the most efficient – but certainly great to look at. Even at low speeds, this is louder than other fans here – that's why it isn't higher on the list – but look at it! Sure, it's RGB, but also somehow a bit sleeker and more refined than other flashy fans. The Hue 2 controller is more attractive than any of the other boxes we looked at too.

HEAD TO HEAD

ShadowPlay vs. Xbox Game Bar

Which is the better video capturing overlay?

■ Nvidia ShadowPlay \$free, www.nvidia.com ■ Xbox Game Bar \$free, apps.microsoft.com

There are now a plethora of screen recording apps available – the days when Bandicam was the preferred option are long gone. You can now use physical devices, such as USB or PCIe Express capture cards from the likes of Elgato or Avermedia, or you can use screen capturing software programs, such as Nvidia's ShadowPlay and Windows Xbox Game Bar. With features such as quick access overlays, performance monitoring, and social interaction options, these offer more than just simple video recording.

What was once a hardware-intensive and expensive way of creating content is now far more accessible and user-friendly. Not only do these apps offer an easy way to help you create content, but they're also highly polished pieces of software, well worth adding to your system. But which one should you choose?

In terms of design, Nvidia ShadowPlay and Xbox Game Bar look pretty similar. Both apps use a light UI, especially with the overlay functionality, which is perfect for seamlessly recording your gameplay. Having to keep swapping in and out of apps isn't ideal, so having shortcuts to

open up each app and start recording is most effective.

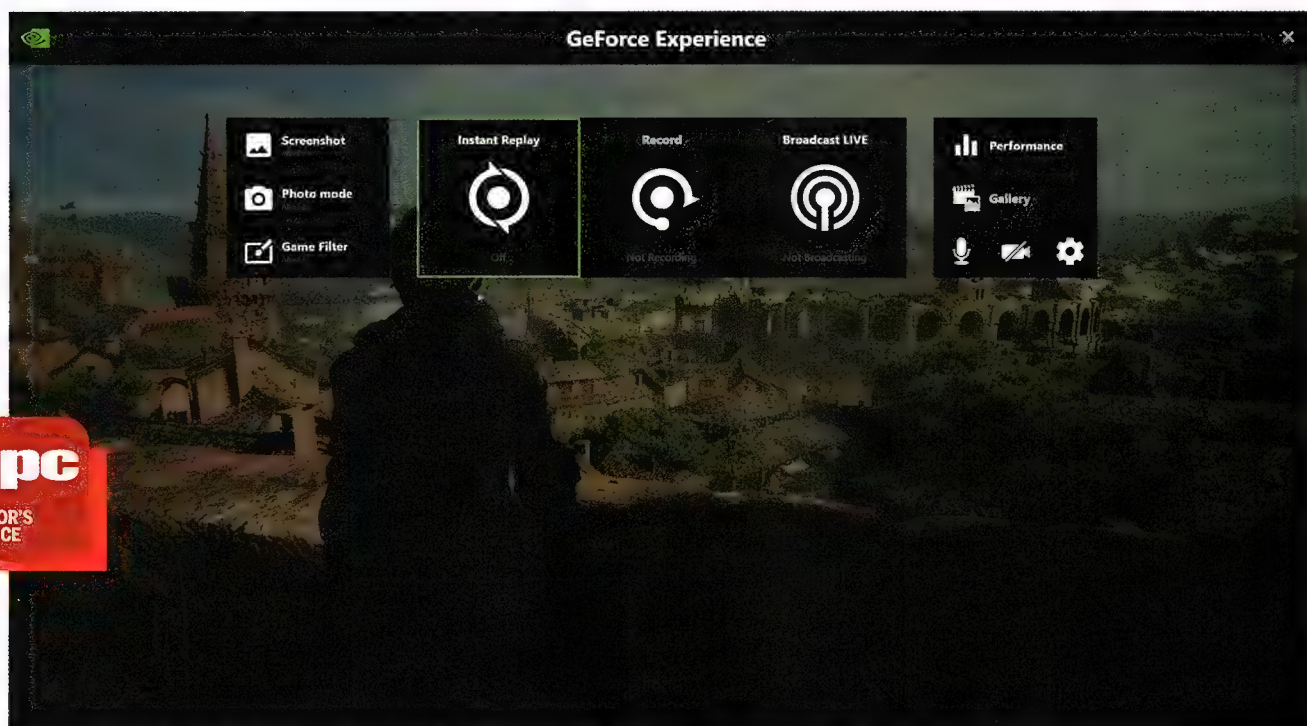
Nvidia ShadowPlay comes within the broader Nvidia GeForce Experience Application. Once downloaded, head to the settings page and enable experimental features. Below that, enable the in-game overlay, which can be opened by pressing the 'ALT-Z' keys. Alternatively, you can press the triangular in-game overlay icon between the notifications and settings icons along the top bar within Nvidia GeForce Experience. With this open, you're greeted by a black and green overlay with a boxy design. Everything here is clear and easy to follow, making it great for quick decision-making on the fly. On the left-hand side are default options for screenshot (ALT-F1), photo mode (ALT-F2), and game filter (ALT-F3).

In the middle, there are three main options for recording and streaming. First, there's an instant replay mode. With this enabled, Nvidia records up to 20 minutes of your gameplay, perfect for grabbing footage you may have missed. In the middle is the most important of them all, the record feature. Click this and you get two

pop-ups, one to start recording (ALT-F9) and the other to open up the settings. Here, you can change the instant replay length in different increments, it also shows you how much storage space your recordings will take up.

You can alter the video quality, choosing between low, medium, high, or custom. In the custom option, you can choose the bit rate/Mbps. The last two settings are the resolution and the framerate of your recording. All of these give you plenty of versatility when recording your footage. To the left of the record button is the Broadcast Live option for live streaming. Again, click this to start (ALT-F8) or to enter the settings. These are almost identical to the settings in the record option, but you can also select a stream destination (either Facebook, YouTube, or Twitch) and custom overlays for your stream which you can open from here.

On the right side are performance settings to monitor your GPU and enable automatic tuning, and also the gallery where you can find your screenshots and recordings, which is handy for keeping things organised.



apc
EDITOR'S
CHOICE

The snappy and effective ShadowPlay app makes recording video content a breeze.



With a UI featuring widgets, linkable accounts, and a game launcher, Xbox Game Bar is the full package.

Below that, there are microphone options, including push to talk, on or off, and a camera icon that lets you turn your webcam on or off. Last but not least, you get the main settings for ShadowPlay. Here, there are choices for your streaming HUD layout, a connect setting to sign in to accounts for streaming, keyboard shortcuts, further access to recording, broadcast, and photo mode or game file settings. You can also play with audio options, choosing your audio source and volume levels. The overlay is quick to open, simple to navigate, has great shortcuts, and when it's set up, easy to get recording or streaming.

Best bar none?

So how does ShadowPlay's rival, the Xbox Game Bar, compare? Unusually, the Game Bar ditches the Xbox green for a white accent design with more rounded corners than Nvidia's offering. In terms of features for the overlay, the two offer similar tools. To open the Game bar, press the Windows-G keys. The software is built into Windows 11, but if it's missing, install it through the Microsoft Store. Alternatively, in your Windows 11 settings, go to the Gaming option in the side menu, then select the toggle to open Xbox Game Bar using the Xbox controller home button. Once into the overlay, the standout point is the center game bar. This houses a controller bar (giving you access to your games and game launchers), the widget menu, audio, capture, performance, resources,

Xbox social, the time, and a settings button.

Widgets work in the Xbox Game Bar just as they do within Windows 11 or an Android phone, for example. The Game Bar can be customized to your taste by editing the UI with these widgets viewable by clicking on the widget button. On our UI, we added the Audio tab to the left, so that we can change the mixer and voice volume levels. To the right, we also added performance monitoring and, most importantly, the capture tab. This is where you can take a screenshot, replay, record, and mute your microphone. Like ShadowPlay, Xbox Game Bar has shortcuts for recording (Windows-ALT-R), capturing a screenshot (Windows-ALT-PrtScrn), and more. These are handy for capturing footage. Underneath, you can view all of your footage by clicking the 'See my captures' button.

In the settings, you can dive in even further to tweak the Game Bar to suit you. The personalisation tab gives you more choices for a light/dark theme and transparency levels. You can also sign in with your social media accounts – here, you get more than Nvidia's ShadowPlay offers. As well as Facebook, Twitch, and YouTube, you can sign into Xbox, Steam, Twitter, Discord, and Reddit. This could be a deal breaker if you want to use the Game Bar with your account on one of these social media sites.

Other than that, there isn't much to separate these two overlays. The Xbox

Game Bar tops it for outright design and customization, thanks to its smooth curved edges. Nvidia's ShadowPlay looks like it's stuck in the Windows 10 era and, while the fact it has less going on makes the UI slightly easier, its resolution and quality features are accessible directly from the overlay, unlike the Game Bar. Go to the Windows settings, then Gaming and Captures to find them – however, there aren't as many options as ShadowPlay.

Although the Game Bar has more outright features and widget options, such as Spotify integration, when we were recording content and streaming, the Nvidia ShadowPlay overlay was quicker, had more in-depth quality control settings, and was our preferred choice, making it our winner here. But pick either of these and you won't be disappointed – they're both well-polished applications and best of all, they're free.

Nvidia ShadowPlay Easy to navigate, detailed quality options and easy shortcuts, but fewer linkable accounts.

Sam Lewis

★★★★★

Xbox Game Bar Nice user interface, great social integration, customisable widget options. Awkward graphic settings and too many eggs in one basket.

Sam Lewis

★★★★☆

Gadgets

Tricky devices.



1

PLAYSEAT TROPHY LOGITECH G EDITION

A neat collaboration for anyone wanting a less intrusive sim racing setup.

US\$599 | logitech.com

Constructed using a lightweight carbon fibre, steel and anodised aluminium frame, the Playseat Trophy is a compact and sleek sim racing seat built for the living room. While it's not quite as sturdy as some of the more advanced driving chairs out there, the rigid frame offers a comfortable solution for gamers that don't have a dedicated space for their driving sim rig and may have to move it from time to time. The PU leather and ActiFit breathable mesh on the seat offer comfort for any endurance sessions and the seat supports Logitech's full range of wheels and pedals that are easy to mount and adjust for the perfect fit.



2

TWELVE SOUTH HIRISE PRO FOR MACBOOK

Rise up and rest easy.
\$179.99 | twelvesouth.com.au

This model of Twelve South's HiRise Pro is a remake of a 2012 laptop stand, adding housing for a MagSafe charger on its base. It also has a smaller footprint than the Twelve South Curve Flex as well as more secure hooks, making the HiRise Pro for MacBooks a better alternative for cluttered desks and peace of mind. The HiRise Pro will let you raise your laptop between 2.5 to 6 inches, but the angle at which your laptop will sit is fixed. That said, it's not too steep, and any laptop from 11 inches to 16 inches should sit quite securely on the stand.



3

GOPRO HERO11 BLACK MINI

Smaller camera, bigger pictures.
\$499.95 | gopro.com/en/au

If you use your GoPro to capture extreme sports or activities where you're not really able to check shots and settings directly on the camera, then the Hero11 Black Mini might be the action cam for you. Yes the Mini misses out on the front and rear LCD displays of the standard Hero11 Black, but for this you get a device that's 14 percent lighter, 25 percent narrower and has both base and rear mounts to make it easier to attach in hard to fit places. The Hero11 Black mini features the same image sensor, HyperSmooth 5.0 image stabilisation and cloud editing technologies as its bigger sibling, in a really simple and compact single-button action camera.



4

THE MORNING MACHINE

The most convenient way to explore the world of single origin coffee.

\$599 | drinkmorning.com.au

Pod coffee is an amazingly convenient solution for instant espresso at home, but, as convenient as it is, there's always been a noticeable difference between it and what you can get from a cafe. That's not really the case any more, however, thanks to The Morning Machine, a Singaporean start-up coffee company that's brought the pod machine into the home-barista era. The

Morning Machine offers customisable pressure and temperature outputs and an inbuilt set of scales to ensure correct dosage and the team have partnered with single origin coffee roasters from around the globe to bring you high-quality coffee in prepackaged pods that cost about the same as a Nespresso capsule.

5

BON.ELK HUB

Plug more in

\$from \$39.99 bonelk.com

We're often left just a port or two short of what we need with our daily laptops. A connected keyboard, mouse and monitor can leave you empty handed on many laptops, and going big with a full dock is absolutely overkill. So these little numbers are a nice solution, and we've been using Bon.Elk gear for a few years now and can testify to the build and materials, and overall sense of quality. The latest range comes in a selection of colours, and can add four USB-A ports, or one USB-A and a pair of USB-C ports. The cables are nicely braided and they do look pretty nice for something that dangles off the side of your machine.



6

BREVILLE THE BARISTA TOUCH IMPRESS

Cafe-level coffee with your favourite milk at the touch of a button.

\$2,299 | breville.com/au

If you want better coffee at home, but don't really have the time or motivation to learn how to be a barista, then Breville's new Barista Touch Impress is built specifically for you. The company has done a lot of research into the main pain points of consumers and has pieced together a set of clever technologies in a machine that requires no real knowledge prerequisites. The Barista Touch

Impress combines the company's recently developed grinding and tamping tools with new automatic milk frothing capabilities and the intuitive touchscreen display to make it the easiest manual coffee machine you can buy.

LAPTOP

Asus Zenbook Pro 14 Duo OLED (UX8402)

A dual-screen Zenbook for creatives that want to boost efficiency on the go.

■ \$3,799 | asus.com/au

It's been a couple of years since we've looked at the last Zenbook Duo 14 from Asus and while there's a lot of similarities, the new Zenbook Pro 14 Duo OLED is a much more premium device. That's

obvious when you consider the \$3,799 cost, which lines up pretty closely with the comparable Dell XPS 15, but the new Zenbook Pro 14 Duo gets a neat OLED upgrade to its main panel, a new 120Hz refresh rate, and a set of new processors to help justify the cost.

This configuration is squarely aimed at creative professionals. Which is a sensible target considering the main point of difference on the Zenbook Pro 14 Duo OLED is the additional multitasking screen. The second screen works really well again on this device, folding up from above the keyboard to add screen real estate and cooling capacity. The primary 14.5-inch OLED screen is, however, the main attraction, offering the full DCI-P3 colour gamut to allow you to accurately work in HDR colour and while it's not quite 4K, the 2880 by 1800 pixel resolution should theoretically be more than enough for a screen this size. Unfortunately we did get a flyscreen effect on the OLED panel when working on white document pages, which isn't a deal-breaker if you can work in dark themes or don't do a lot of document work, but it's a distracting artefact for those that do.

Performance on this device was

"Performance on this device was excellent with the Intel Core i7-12700H CPU and Nvidia GeForce RTX 3050 Ti working well to deliver pro laptop performance that you'd expect of gaming laptops."

apc
HIGHLY
RECOMMENDED



■ W11 Home; 14.5-inch OLED 120Hz primary display at 2880 by 1800 pixel resolution, and 12.7-inch IPS ScreenPad Plus IPS display at 2880 by 864 pixel resolution; Intel Core i7-12700H CPU; Nvidia GeForce RTX 3050 Ti GPU; 16GB RAM; 1TB M.2 NVMe PCIe 4.0 SSD; 32.3x22.5x1.96cm; 1.75kg.

excellent with the Intel Core i7-12700H CPU and Nvidia GeForce RTX 3050 Ti working well to deliver pro laptop performance that you'd expect of gaming laptops. This means you can feel secure that there's enough horsepower to do moderate creative work on demanding applications. You'll need to bring a power cable in order to really work on the Zenbook Pro 14 Duo OLED since battery life is only a bit over five hours for work and less for movie playback, but the thermal management is solid so the device doesn't need to curb long term performance when it's connected.

If you're planning on utilising this device's capabilities in your down time too, the 120Hz display works well with the discrete GPU to get 40-plus framerates on modern titles using 1080p settings. That second screen is also really handy while gaming, as a second screen for chatting, streaming software or whatever other additional distraction you might want.

The Vesa True Black HDR 500 is brighter than Dell's XPS 15 offering, but there is a tradeoff for resolution here. The Gen 4 PCIe SSD is competitive with 7031/5227 read and write speeds and 16GB of RAM is enough for the vast majority of use cases.

While the keyboard might look eccentric, it's actually got a nice layout and the keys have good travel distance. The right side trackpad takes a bit of getting used to (especially if you're too young to be well acquainted with retro physical left and right trackpad buttons), but it's perfectly workable.

A great pro laptop with unique second screen capabilities that has a minor screen issue when looking at documents.

Joel Burgess

★★★★☆

	Asus ZenBook Pro 14 Duo OLED (UX8402)	Dell XPS 15 (2022)
Geekbench 5 - Single-core (score)	1,664	1,730
Geekbench 5 - Multi-core (score)	11,811	11,379
Cinebench R23 - CPU (multi-threaded)	14,036	13,500
3DMark - Time Spy (score)	5,156	4,482
RDR II - Ultra 1080p (ave. fps)	61	DNT
Battery life - 1080p video playback (h:min)	03:05	10:07
CrystalDiskMark Read (MB/s)	7,031	6,887
CrystalDiskMark Write (MB/s)	5,227	4,431

SYSTEM

MSI MEG Trident X2 13th

A premium gaming PC with an eye watering price.

■ \$12,499 | www.msi.com

Any PC enthusiast can understand the appeal of top spec gear, even if it's outside of one's price range. But there's premium pricing and then there's ludicrous pricing. While the MSI MEG Trident X2 13th is an appealing top spec PC, at \$12,499 it's definitely in the ludicrous category.

At that price, it has to have the best of everything. An Intel Core i9 13900KF is a powerhouse CPU. It's cooled by an MSI 280mm AIO cooler. A mighty MSI RTX 4090 Ventus 3X takes care of the gaming duties. So far so good.

Less impressive is the choice of 64GB of DDR5-4800. There are plenty of apps that can use loads of RAM but games prefer speed over high capacity, and 32GB of DDR5-5600 or 6000MHz would make more sense in a rig aimed at gamers. Also, the USB complement is a bit on the weak side. There are only six USB ports on the rear panel. That's unbecoming of a system such as this.

You get a 1000W Gold rated PSU, Samsung 2TB PCIe 4.0 SSD and Seagate Barracuda 2TB HDD. At over 12 grand, a bit more than 2+2TB would be more appropriate.

The design of the Trident X2 is likely to generate some polarised opinions. There is a certain subtlety to it though. It doesn't have a tempered glass side panel so apart from the front mounted touch screen and RGB strip, its look is rather reserved. The eye-catching screen at the front of the case is what MSI colourfully names the Human Machine Interface, or HMI. It's a 4.5-inch touch panel with a variety of uses. It can show things like the system's status, monitoring information and a lot more. It's



■ Intel Core i9 13900KF CPU; 64GB DDR5-4800MHz Memory; MSI GeForce RTX 4090 Ventus 3X GPU; Samsung 2TB PCIe 4.0 NVMe SSD, Seagate 2TB HDD; 487 x 222 x 453 mm Dimensions.

actually useful. It can even control MSI's monitors should you wish to do that instead of using the monitor itself. If you really want.

Despite its use of MSI components, the Trident X2 is not designed to be upgradeable apart from the SSDs. The screws to access the rest of the system are covered with warranty void stickers, meaning you are discouraged from accessing the RAM, GPU or motherboard. If we're to spend this much on a system, the ability to add a next gen GPU in a couple of years really should be allowed.

Any system with flagship tier components is going to perform well, and the Trident X2 13th certainly does, though its CPU performance is a little lacking compared to some systems due to MSI's strict adherence to the 13900KF's power limits. The flipside is that the 280mm cooler is able to keep a lid on temperatures, without resorting to banshee-level fan speeds.

Its gaming performance is excellent. The Trident X2 13th is easily able to play any game at 4K.

The MSI MEG Trident X2 13th is an attention-grabbing PC. Though its lack of upgradeability and below par USB complement count against it, it's still a very powerful machine.

But that price! Ouch! \$12,499 is thousands of dollars too much. You can get a prebuilt system with similar performance for well under \$10,000. That means the Trident X2 13th has to be a hard pass until it gets a downward price adjustment, and a big one at that.

The MSI MEG Trident X2 13th is a powerful and unique gaming PC, but at this price? Forget it.

Chris Szewczyk

★★★★☆

		MSI MEG Trident X2 13th	Mwave Respawn Ninja Beast Mode Alpha
Handbrake 1.6	Video conversion 4K to 1080p FPS	84.1	92.2
Cinebench R23	Rendering - Multi thread Score	36,441	38,678
Cinebench R23	Rendering - Single thread Score	2,236	2,150
3DMark Storage Benchmark	Score	2,941	2812
3DMark TimeSpy	Overall score	16,725	18,535
	CPU Score	34,671	36,841
Cyberpunk 2077	1440p, RT Ultra, Avg FPS	59	63
Metro: Exodus	4K, Ultra, Avg FPS	70	71

GRAPHICS CARD

Intel Arc A750

Exceeding expectations.

■ \$389 | www.intel.com

Regular readers of APC might have wondered why we've never covered Intel's Arc graphics cards? The simple reason is that Intel chose not to sample them to Australian media. That all changed recently, and let us say straight up, the wait was worth it.

Bashing Arc has been a bit trendy. At the time of the launch in Q3 of 2022, many criticisms were deserved, but after several months of driver development, the Arc A750 we have for review has ended up as a genuine contender in the mid-range GPU market. For all the talk of RTX 40 and RX 7000, the models released so far are priced well beyond the range of typical gamers, so the Arc A750 at under \$400 is a very welcome breath of fresh air.

The Intel Arc A750 is based on Intel's AACM-G10 GPU. It's a slightly cut version of the one found in the A770. It includes 28 Xe Cores or 3594 Shader Units in traditional GPU speak. It has a boost clock of 2,400MHz, a 225W TDP, 8GB of 16Gbps GDDR6 memory and a welcome 256-bit bus. It supports the full DX12 feature set, ray tracing, and Intel's impressive XeSS upscaling technology.

The Intel reference card reminds us of Nvidia's RTX 20 reference cards. It looks fantastic in its all black finish. It comes with six and eight pin PCIe power connectors along with a single HDMI 2.1 and three DP 2.0 outputs.

Overall performance is much better than we expected. There are still some inconsistencies, but comparing it to cards around its price range, namely the popular Nvidia RTX 3060 12GB and AMD RX 6600 XT, we get some very interesting results. In some games, the A750 blows both away while lagging in



"Overall performance is much better than we expected. There are still some inconsistencies, but comparing it to cards around its price range, namely the popular Nvidia RTX 3060 12GB and AMD RX 6600 XT, we get some very interesting results."

■ 3,584 Shader Units; 2400MHz boost clock; 8GB GDDR6 16Gbps memory, 512GB/s memory bandwidth; 3x DisplayPort 2.0, 1x HDMI 2.1; 225W TDP, 1x 8-Pin, 1x 6-pin power connectors.

others. Let's take *Metro Exodus*. With ray tracing enabled, the A750 is nearly 50 percent faster than the 3060 and 6600 XT! While in *Far Cry 6*, it lags both by a sizable margin.

While Arc's performance inconsistencies remain, Nvidia and AMD won't be shuddering in padded rooms, but Arc is definitely improving, and both companies are surely going to be wary of Intel's driver development and follow up Battlemage and Celestial architectures. A company like Intel has the expertise to really threaten the status quo.

The A750 is a compact card but at no

stage does it get loud. A recorded load temperature of 72 degrees is pretty good for a card of this size with a 225W TDP. Note that you'll need good case airflow though, as the backplate in particular gets hot under sustained loads.

As long as you don't expect RTX 4090 or 7900 XTX levels of performance, we have no problem with the Arc A750. Would we buy it over something like an RTX 3060? That's a much harder call than it was six months ago when we would have said no, but with six months of driver development under its belt, and surely more to come, the A750 cannot be overlooked. We're yet to see mid-tier RTX 40 and RDNA 3 competitors. They will pile pressure on Intel, but for now, the A750 is very competitive indeed.

Intel, you have our respect. But more than that, at under \$400, it's a card that delivers genuine value too, and for that we're especially grateful.

Intel's rapidly maturing Arc A750 delivers underrated performance. At under \$400 it's a very good budget gaming option.

Chris Szewczyk

★★★★☆

		AMD Radeon RX 6600 XT	Nvidia GeForce RTX 3060	Intel Arc A750
Total War: Warhammer III	1920x1080 Ultra Preset - Avg	65	70	65
F1 2021	1920x1080 Ultra High Preset- Avg	98	94	100
Far Cry 6	1920x1080 Ultra Preset- Avg	118	100	92
Metro: Exodus Enhanced Edition	1920x1080 Extreme Preset- Avg	33.3	35.7	48.7
Temperatures (C)	Full system power (w)	234	254	301
	Peak load	73	64	72
3DMark	Time Spy Extreme	4,705	4,440	6,376

MOTHERBOARD

MSI MAG B760M Mortar Max WiFi

An overclockable B760 board! But there's a catch...

■ \$419 | www.msi.com

Do you remember the days when you could take a budget processor and overclock it to get flagship-level performance? It didn't require a \$1,000 motherboard, 360mm AIO or a CPU with an unlocked multiplier. You could do it by increasing the base clock. In some cases, a 100 percent overclock was possible. The Core 2 Duo E6300 springs to mind.

Budget overclocking has mostly fallen by the wayside in favour of dynamic Turbo modes and variable power delivery. When 12th Gen CPUs launched, there was a lot of chatter among enthusiast circles as news spread of the possibility to overclock locked 12th Gen CPUs via base clock. The really exciting part was that a handful of B660 boards had the ability too. Cheap as chips overclocking was back! Sadly, Intel wasn't feeling too altruistic and it closed this loophole, but only for 13th Gen CPUs.

So, despite the loss of 13th Gen bclk OC, the MSI MAG B760M Mortar Max WiFi retains the ability to overclock a 12th Gen locked CPU. A feature we took advantage of to see how far we could push an i5 12400 CPU, achieving 5.2GHz on all cores, much higher than its default peak Turbo clock of 4.4GHz.

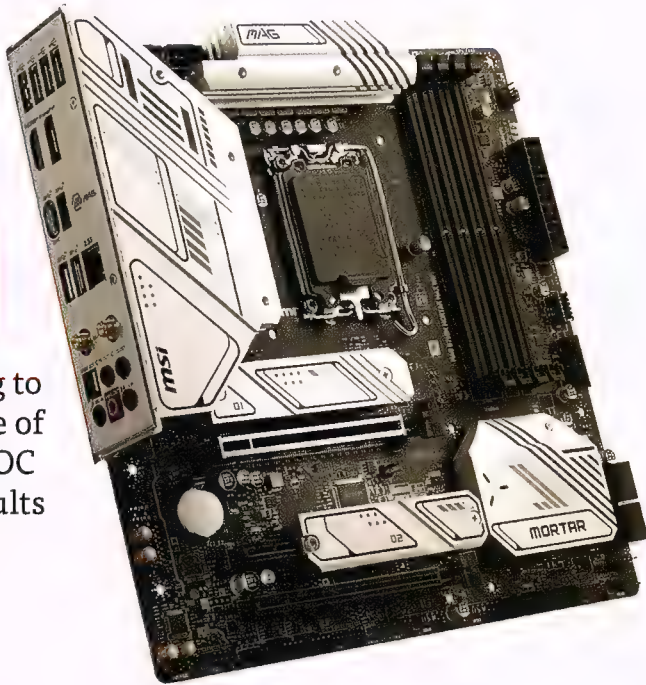
The B760M Mortar Max WiFi isn't a one trick pony though. At over AU\$400 it's one of the most expensive B760 boards, and luckily its feature set goes a long way to justifying its relatively steep price.

The Mortar Max features an attractive brushed metal on black design, free of RGB adornments. It supports up to 192GB of non-binary DDR5 memory at speeds of up to 7000MHz.

You'd expect a board designed for



"If you're going to take advantage of its base clock OC ability, the results are simply awesome."



■ LGA1700 Socket; 2x M.2; 6x SATA; Up to 1x USB 3.2 Gen 2x2, 4x USB 3.2 Gen 2, 2x USB 3.1 Gen 1, 8x USB 2.0; Intel Wi-Fi 6E; Realtek 2.5G LAN; Realtek ALC897 7.1 Channel HD Audio; Micro ATX Form Factor.

overclocking to have a high quality VRM. A 12+1+1 phase design with 75a stages is enough to power a 13900KS let alone a less demanding 12th Gen model. The heatsinks are excellent and keep the VRM under 50 degrees.

Two M.2 slots support PCIe 4.0 drives. You get six SATA ports too, even some much more expensive Z790 boards only include four in this day and age.

The I/O of the board is good. There are four USB 2.0 ports and three 10GB/s Gen 2 ports. These are joined by a 20GB/s USB 3.2 Gen 2x2 port. These are rare on B760 boards and it's one of those features that elevate a good B760 board.

Intel Wi-Fi 6E and Realtek 2.5G LAN controllers take care of networking duties, while Realtek ALC897 provides audio. HDMI 2.1 and DP 1.4a ports add a bit of flexibility for use with onboard graphics.

As you'd expect from a mature platform, the board performs almost identically to other B760 boards. But if you're going to take advantage of its base clock OC ability, the results are simply awesome. An overclocked 12400 is able to match an 8-core i9 11900K at multi-threading, while easily dispatching it under single threaded loads. If only Intel allowed it on 13th Gen processors! We all know why it doesn't. It'd take away sales of more expensive processors.

The B760M Mortar Max is an excellent all round motherboard with a quality feature set. Sadly, not too many people will take advantage of its key feature but even if you don't, you'll be getting a board that gives some more expensive Z790 boards a run for their money.

The MSI B760M Mortar Max WiFi is a classy and feature rich board with a killer OC feature that we may not see the likes of again.

Chris Szewczyk

★★★★★

		MSI B760M Mortar Max WiFi	Asrock B760M Sonic WiFi
Handbrake 1.6	Video conversion 4K to 1080p FPS	144.9	145
Cinebench R23	Rendering - Multi thread Score	36,419	36,086
	Rendering - Single thread Score	2,285	2,269
7Zip 22.01	File Compression - Billion Instructions per second	203.38	198.32
3DMark TimeSpy Extreme	Overall score	18,218	18,119
	CPU Score	12,965	12,615
Ghost Recon: Breakpoint	1080p, Low, Avg FPS	318	306
Metro: Exodus Enhanced Edition	1080p, Ultra, DX12, Avg FPS	154.1	155.0
	1080p, Ultra, DX12, Min FPS	94.8	95.8

GAMING LAPTOP

Lenovo Legion Pro 5i 16IRX8

13th Gen intel CPUs and 40 series Nvidia GPUs have landed on Lenovo's Legion Pro gaming rigs.

■ From \$3,659 | lenovo.com/au

You probably know Lenovo for its flexible Yoga range, but the Legion brand has had a pretty solid gaming laptop offering over the last few years. Central to this range is the performance-first Legion Pro 5i gaming laptop that takes a pretty traditional 16-inch gaming chassis outline and puts some of the best mobile gaming components you can get into it.

The headline feature of this device is that it's the first through APC's door with updated 13th generation Intel mobile processors and a Nvidia 40 series GPU. The device we tested came with an Intel Core i9-13900 CPU, 32GB of RAM and a Nvidia RTX 4070 GPU, but the unit can be configured with your choice of two 13th gen i7 CPUs; a 4060, 4050, or 3050 GPU; and various RAM and storage options.

The i9-13900 CPU has a total of 24 cores, 8 of which can boost up to 5.6GHz when needed, which is a massive expansion of hardware capabilities. This translated to 60 percent performance improvements in heavily multi-threaded tasks like video rendering over the Intel Core i9-12950HX and up to 25 percent improvements on general work tasks. This added performance does draw extra power with the powerful chip's base draw rated at 65W, but this year's Legion Pro 5i managed to improve on the battery life of its predecessor, lasting 4 hours and 47 minutes in PC Mark 10's Modern Office Battery benchmark.

The Nvidia RTX 4070 on the Legion Pro 5i offered a similar story. With a max power draw of up to 140W allocated, this GPU showed up to 48 percent performance improvements over last year's Legion 5i Pro Gen 7 with a 150W 3070 Ti in real world gaming benchmarks. It was even capable of outpacing some of last year's gaming



■ W11 Pro; 16-inch 240Hz display at 2560 by 1600 pixel display, 3ms response, 500nit, VESA HDR 400, G-Sync, X-Rite Pantone; Intel Core i9-13900 CPU; Nvidia GeForce RTX 4070 GPU; 32GB of RAM; 1TB NVMe SSD; 84Wh (2h 36min 1080p movie playback); 36.3 x 26 x 2.7 cm; 2.49kg.

rigs with lower powered 3080 Ti GPUs, which sets the bar high for gaming laptops in 2023.

These impressive performance specs combine with the fast 240Hz WQHD screen for an excellent balance of resolution and refresh rate. Considering how high end the rest of the specifications are we're a little disappointed that there was no option for 4K, but if you crank ray tracing to Ultra in Cyberpunk 2077 you'll only get 48fps averages in 2560 by 1600 pixel resolution, so it makes sense to limit the screen to this configuration. While the display is only rated to reproduce the

sRGB colour spectrum, there is an HDR setting that'll allow you to experience HDR-like colours and Vesa has certified it as HDR 400 compliant.

We did have a few niggly issues with the automated GPU switching technology in this device since every now and then you'd hit momentary screen freezes while the device shifted graphics responsibilities from the integrated Intel UHD Graphics to the Nvidia RTX 4070, but you can always turn off the auto-switching if you don't need battery life or gaming grunt and the tech should save battery life for anyone that wants it.

Don't expect to leave home without a charger since you won't make it through some movies without topping up and while it's portable for a full-fat gaming workstation, it's much bulkier than slim gaming ultrabooks. Thermals, keyboard and trackpad were all solid and there were no other major limitations to be found.

A great initial release using the latest gaming components on the block.

Joel Burgess

★★★★☆

	Lenovo Legion Pro 5i 16IRX8	Lenovo Legion 5i Pro Gen 7
PCMark 10 - Overall (score)	7176	6,754
Cinebench R23 - CPU (Score)	25,760	14,185
Max CPU Temperature (C)	99	97
1080p movie playback (HH:MM)	02:36	02:11
3DMark Time Spy (score)	11,602	10,978
FT 2021 - 1080p Ultra (fps Av.)	141	95
CrystalDiskMark Read (MB/s)	6,579	7,058
CrystalDiskMark Write (MB/s)	4,928	5,285

OLED MONITOR

BenQ Mobiuz EX480UZ

Go big (and pricey) with this 48-inch OLED monitor.

■ \$2,399 | benq.com/en-au



How big is too big for a gaming monitor? Competitive gamers prefer them small and fast, while single-player gamers tend to go big and colourful. The BenQ Mobiuz EX480UZ aims to cater to the latter group, combining all of the benefits of an OLED TV with the features of a gaming monitor.

The EX480UZ is a massive 48-inch 4K OLED screen with a refresh rate of 120Hz and support for HDR10. This monster OLED does a great job of making PC games pop while also offering the sort of insane scale that benefits cinematic, story-driven titles. The big difference between these large OLED monitors and similar TVs is connectivity. This has a more PC-friendly DisplayPort and two console-friendly HDMI 2.1 ports. It also has two USB 3.0 ports, a 90W USB Type-C downstream port to charge your devices, a USB Type-B port, and a S/PDIF jack. That's pretty impressive, though an extra HDMI port or two would have been handy.

The ergonomics of the Mobiuz aren't great as a PC monitor. The legs take up a lot of space, so you'll need a large desk to make this thing work. It also has a limited tilt, meaning you could have trouble finding a comfortable viewing angle.

■ Screen size: 48-inch; Resolution 3,840 x 2,160; Brightness (peak): 450 nits; Response time: 0.1ms GTG; Refresh rate: 120Hz; Viewing angle: 178° H&V; Contrast ratio: 135,000:1; Features: 98.5% DCI-P3, adaptive sync, DisplayPort 1.4, 2x HDMI 2.1, USB Type-C, USB 3.0, Remote, KVM, HDR10 Hotkey, Built-in speaker.

Ideally, you want space between your face and a monitor of this size but with the Mobiuz being so huge, there's no way to safely push it back without it falling off most desks. That distance can make things uncomfortable for a day of working – sitting so close presents issues with text readability, even with text scaling applied.

That said, the Mobiuz deserves some praise in the looks department. *Spider-Man: Miles Morales* looks fantastic on this monitor, and as long as you have a powerful GPU to drive it, watching Miles zip around New York City in 4K at 120Hz never gets old. As always with PC gaming, HDR mode can be hit and miss – the contrast in *Hitman 3* and *Gears V* felt a little off in darker areas, but it didn't ruin the vibe.

The issue is the price, with the Mobiuz listed at \$2,399. Compared with OLED gaming TVs of that size, the LG C2 is cheaper at \$1,700 and is often available for a lot less, plus it offers lots of apps and 'TV' features out of the box.

The BenQ Mobiuz EX480UZ is yet another large OLED that looks incredible

and is fantastic for gaming, though it's a little impractical (and expensive) for most PC gamers. It has superb picture quality and a speedy response time, but its price and impracticality keep it from being a truly great monitor.

There are also several sizable 1440p 240Hz OLED gaming monitors due on the market, which feels like the current sweet spot for PC gaming. There's still a place for 4K 120Hz on screens of this size, but they also require RTX 4090 cards to drive them, something that means they are very much a luxury item for most.

The BenQ Mobiuz EX480UZ is a solid choice if you want to adopt the large gaming monitor lifestyle. It's got the speed, colour, and contrast you want for PC and console gaming. However, its limited ergonomics and high price make it hard to fully recommend over some of its competitors.

Great colour and contrast with excellent response time but it's expensive, has poor ergonomic design and needs more HDMI ports.

Jorge Jimenez

★★★★★

MONITOR

Samsung 34" Odyssey OLED G8 Curved WQHD Gaming Monitor

Samsung's backing a sure thing by adding smart TV functionality to 2022's top laptop screen, but is everything on the G8 as good as Alienware's AW3423DW?

■ \$1,999 | samsung.com/au



2023 is a year that's looking like it'll have more options in the premium monitor space than ever before, with Samsung deciding to release variations of its top-end monitors that come with either OLED or Neo (Quantum Mini-LED) display technologies. The 34-inch Odyssey OLED G8 is the middle of the Odyssey range; larger than the professional-gaming focused Odyssey G6, but less extravagant than the 49-inch and 57-inch flagship Odyssey G9 units.

A 34-inch Ultrawide is right in the sweet spot for offering the best value for a highly immersive screen and the G8's QD-OLED panel is the same as the one in the Australian PC Awards 2022 best screen, the Alienware

AW3423DW QD-OLED gaming monitor. Samsung's new screen also offers inbuilt Smart TV functionality, which means it has all the key ingredients already included to be a highly desirable all-purpose screen, but there are some minor concessions that make it feel not quite as impressive as Alienware's 2022 attempt.

"A 34-inch Ultrawide is right in the sweet spot for offering the best value for a highly immersive screen."

■ 34-inch Ultrawide QD-OLED display at 3440 x 1440 pixel resolution; 1800R curvature; 21 by 9 aspect ratio; Typical Brightness 250 nit (Peak ~400 nit); Vesa DisplayHDR True Black 400; 175Hz max refresh rate; 0.03ms Response Rate (GTG); 99%DCI-P3 HDR Colour; 81.4 x 52.2 x 19.3 cm; 7.5kg.

Setting it up correctly

The most notable is that the Odyssey OLED G8 isn't quite as bright as we remember the Alienware AW3423DW to be, and even after we tweaked every image quality setting available, the typical 250 nit brightness just wasn't enough for us to get the same visceral

experience as what we got from Alienware's iteration. One thing that did make a massive difference was Microsoft's inbuilt HDR settings – you need them on to ensure you have access to any of the

HDR colour gamuts, but the default picture settings make the blacks on the screen look really washed out.

Using all the settings highlighted in the boxout, calibrating the display using Windows HDR and having the colour set to the DCI-P3 gamut allowed the screen to really come alive. It's a lot of hoops, but when you jump through all of them

the 34-inch Odyssey OLED is an exceptionally vibrant display that is excellent for both work and gaming.

There are some settings that allow you to raise the peak brightness constraints, but we could still only get it to show distinguishable definition at around 400 nits. We suspect that the constrained peak brightness is in part due to mitigating the risk of burn-in which isn't common, but is still possible on today's OLED panels. The Alienware QD-OLED screen came with a 3-year replacement/service warranty, which seems like a really sensible way to quell consumer fears about one of the few serious limitations of OLED. As a result there really aren't any consumer complaints about the Alienware display online after a year of public consumption, but Samsung don't seem to have any specific warranties for burn in... or at least none that it's promoting, so it feels a bit more risky than the Alienware offer. They did, however, offer to throw in a bonus Samsung SSD 990 PRO 2TB M.2 storage (\$389 RRP) with any pre-orders.

Other than those two concerns

TWEAKING THE G8

Expert Picture Settings	APC recommended settings
Brightness	25
Contrast	25
Sharpness	10
Colour	25
Tint (G/R)	0
Contrast Enhancer	Off
Colour Tone	Standard
Gamma	ST.2084
- ST.2084	-3
Shadow Detail	-1
Colour Space Settings	Custom
Colour Gamut	DCI-P3
Peak Brightness	High
VRR Control	On
Adaptive-Sync	On
Refresh Rate	175Hz



everything else is pretty awesome. You've got Ultra-wide QHD resolution with 99 percent coverage of the DCI-P3 HDR colour gamut. You'll be able to run that resolution at up to 175Hz with an ultra low response rate of 0.3ms. And while you'll have to utilise standard cross-platform G-Sync compatibility, for those with AMD GPUs you'll get slightly bolstered Freesync Premium.

The smart TV monitor

The inclusion of Smart TV functionality could have been a major win for Samsung... and if you're hoping to use this device as a living room PC then it's not a bad option with plenty of streaming services and Xbox compatibility baked in, but in some ways it's not the perfect living room PC display. While the 1800R curve isn't too intense, we know that curved TVs weren't overly popular and most TV content can't utilise the ultra-wide format (so you'll have big black bars at either edge of the display to accommodate 16:9 pictures). While you do get VESA DisplayHDR 400 at a peak of 400 nits, this is much less than standard HDR TVs which require a minimum 1,000 nit peak brightness for HDR content, a fact that you'll notice when you're 10-feet from the unit.

When it comes to use as a Smart TV

"Perhaps what Samsung has done the most work on however is the overall aesthetic of the monitor."

the menu interface is pretty comprehensive, but the remote that accompanies the device hasn't really been tweaked to be great for a PC monitor. Overall a lot of the PC settings feel tucked away further than they need to be and there's no 'Settings' button directly on the remote. There is a workaround that allows you to hold the Play/Pause button to jump to the 'Game Menu', but it only works when game mode is turned on and doesn't directly allow you to change picture quality. The joystick controls on the back of the unit also won't allow you to exit from all menu interfaces, which seems like a pretty important omission. There's no deal breaking features missing from the menus, but there is definitely more optimisation that could be done to integrate PC options and Smart TV menu interfaces better.

Perhaps what Samsung has done the most work on however is the overall aesthetic of the monitor. If you care more about looking at the back of your display (or inside your PC) than at the screen then this should be exciting since the Odyssey G8's overall aesthetic is great. The bezels are millimetre-thin on all sides and wrap around the back into a slim design that looks sleek and futuristic. While there is a pop of colour

in the Core Lighting + chamber at the rear of the unit that should please any gamers, the rest of the display is subtle enough to work with a modern office aesthetic. The silver stand offers solid stability and allows for a good degree of height variation and tilt, to make it comfortable in multiple positions.

Conclusion

All up this is an excellent display that will make games look vibrant for anyone with a solid gaming PC; say a 2080 or 3070 Ti GPU. It's also a compelling offering for anyone needing a colour accurate display for work since it's capable of meeting enough of the DCI-P3 space and the 1440p ultrawide format is enough resolution for side-by-side office apps and web pages to look really sharp.

While we would categorise the burn-in risk as low, if you're spending this much on a display you want to know it's not going to break in the next 3-5 years and without a standing warranty Samsung puts that risk back onto buyers. This combined with a slightly duller display and an imperfect menu system holds the Samsung 34-inch Odyssey G8 back from being a truly killer 2023 offering.

An excellent QD-OLED Ultra-Wide 1440p screen with pro HDR colour and 175Hz refresh rates that is just a bit of a gamble when it comes to burn in.

Joel Burgess

★★★★☆

CASE

Asus Prime AP201 MicroATX case

A compact case with big flexibility.

■ \$129 | www.asus.com



Asus' wide portfolio of products are well covered in these pages, but less so are the company's cases. You might be aware of its high end ROG and TUF themed models, but it makes mainstream cases too, like the Asus Prime AP201 we have for review today. Perhaps most surprising of all the AP201's price, at just \$129.

The AP201 is a compact case designed to house MicroATX and Mini-ITX motherboards. We have the white version on hand for our review, but there's a black option too. The white version is more of a natural match with the Asus Prime motherboard range, which features silver and white highlights. It has a wide-open mesh design, allowing it to house hot components without compromise.

The case has an understated look, free of garish adornments while the top and sides of the case are covered in perforations to maximise airflow. It's a screwless design. The side and top panels are securely attached yet are still easy to remove. A magnetised fan filter at the bottom is welcome. Overall the build quality is excellent, with sturdy feet and a classy look and feel.

The AP201 is able to house a top mounted radiator up to 360mm in size in addition to a rear mounted 120mm radiator or fan, meaning it'll have no

■ Dimensions: 205mm x 350mm x 460mm; Weight: 5.8 Kg; Front I/O Ports: 1x USB 3.1 Gen 2 Type-C, 2x USB 3.1 Gen 1, 2x 3.5mm headset jacks; Cooling: 1 x rear 120mm fan (supports up to 6 x 120mm fans) Maximum GPU length: 338mm.

problems handling the hottest CPUs. All up the AP201 can house up to six 120mm fans.

Up front, you'll find a single USB 3.2 Gen 2 Type-C, a pair of USB 3.0 Gen 1, mic and headphone ports and the power button.

Building a system with the AP201 is mostly straightforward, though the PSU location is a little different to a standard ATX case, it's still easy to install. As for storage, the AP201 allows you to install up to four drives. Two can be installed at the bottom and front of the case, while another can be placed behind the motherboard tray. You can choose between placing fans or drives at the bottom of the chassis. Overall, it's a very flexible design.

The case can house GPUs with a length of up to 338mm. That's enough for most, but not all graphics cards. Some of the latest cards are truly enormous, so definitely check to be sure if your choice of graphics card will fit.

The cable management options are welcome. A pair of simple Velcro ties helps to keep everything neat and tidy,

while there's plenty of space to allow a stiff 24-pin cable to be routed out to the motherboard. There are plenty of slots and notches for cable ties too. The end result is a clean and functional build with more than adequate airflow, particularly if you deck it out with the full fan complement.

The mATX market can get overlooked. These days most cases seem to be designed for standard ATX motherboards with Mini-ITX at the other end of the spectrum, so thank you to Asus for continuing to cater for the mATX market. If you're after a no-frills compact mATX case to hold (almost) full sized components, with unrestricted airflow and perhaps most importantly – a great price, the Asus Prime AP201 may be the case you've been looking for.

The Asus Prime AP201 is an excellent case with unrestricted airflow and lots of flexibility. At \$129 it's great value too.

Chris Szweczyk

★★★★★

CASE

Corsair iCUE 4000D RGB Airflow

A venerable classic gets a practical refresh.

■ \$239 | corsair.com



The Corsair 4000D is a bit of a classic, and has been around for a good couple of years now. It is evolved from Corsair 350D and 450D models from several years ago, or at least it appears that way when you compare them. It's popular with DIY builders for good reason.

Corsair has continued to refine the design, and it's had a refresh so we're taking a look at what's new, and why this case is a gem.

Clean looks come first. The design is tasteful and elegant, with just enough flourish to please, but not embarrass you. The 'Airflow' model replaces the front tempered glass panel with a grille cut in the same diamond pattern as the other vents here, and in black it looks very sharp indeed.

Corsair has fitted three 1200mm AF120 RGB Elite fans to the front, and the airflow into the interior is unimpeded by any protrusions or blockage points. The spacing of the

diamond cuts in the grille is large, and the case is filled constantly by enough gusting wind to keep the entire inside well fed by moving air. No rear exhaust fan is included, or top fans, but the 4000D RGB Airflow comes with Corsair's iCue Lighting Node Pro

controller, which supports up to a very generous 12 connections.

An AIO of up to 360mm can be installed, though the 4000D is a fairly compact case so you're limited to the frontal area only if you want to go big with a 360 rad. If you're also planning on installing an Nvidia 40 series card you'd better measure carefully first. It can

accommodate a graphics card up to 360mm in length with the included front fans left in place – but with most of these new Nvidia cards right on the limit of that length there simply won't be room anymore for a 360 AIO.

Building is also a cinch with the

"Building is also a cinch with the 4000D RGB Airflow. Everything is easily accessible, and around the back there's a convenient cable management channel to help avoid squishing cables."

4000D RGB Airflow. Everything is easily accessible, and around the back there's a convenient cable management channel to help avoid squishing cables. The slide-off tempered glass side panel is held in place by two captive screws, though they are hand-tighten screws only, so a screwdriver won't be any help to you in a few years when they're jammed tight.

Most connectors – USB, audio etc – are labelled clearly with large tag next to the plug end, which will need to be removed after assembly if you want a clean look.

The only downside we found was that the top mesh, which attaches magnetically, is extremely thin and if you're not careful during assembly it can easily bend and crease if it's moved around carelessly.

Such is the 4000D's lineage, Corsair offers a variety of upgrades to customise the look, with a bamboo front panel looking especially classy. It's cut in the same high-airflow mesh pattern, too, so you aren't sacrificing cooling performance for looks.

A fine choice for a clean looking and well cooled PC.

Ben Mansill

★★★★☆

COOLER

Corsair iCUE H100i Elite LCD XT

Now with better fans and more things that glow.

■ \$419 | corsair.com



Corsair's venerable H100i series of AIO CPU coolers gets another iterative upgrade with the new LCD XT model. As the name suggests, one of the new features is indeed a new pump cap with a bright and sharp LCD screen. Via the iCue app it can be customised in many ways, with the outer and inner ring independently configurable for colours and patterns, and many options for what the screen displays, and the graphics style. You can of course add your own images. The most practical setting is CPU temp and load. The LCD head attaches magnetically, and once you've built your rig it's all nice and solid, but it did get knocked loose a few times during assembly. It's also sold separately if you'd like to add the LCD pump cap to earlier versions of the Elite Capellix.

That's not the only upgrade. This new H100i model also gets an RGB version of Corsair's AF Elite fan, which the company claims are the best performing fan it makes. Better

quality XTM70 thermal paste is also included as part of the evolution of this cooler.

We tested a Ryzen 9 7900 at its stock TDP of 65w, which ran at 90w under Prime 95 with all cores at 100 percent, and saw an average of 58 degrees with the two fans and pump set to Quiet mode (~1400rpm). Changing the fans and pump to Balanced (~2150rpm) reduced the temps to 56 degrees –

"It is very quiet, and that's a huge plus. The pump noise is virtually imperceptible, even at the highest RPM setting."

showing that the Quiet mode is absolutely fine for all but the hottest CPUs. We then enabled PBO to see how it handled the extra heat, pushing the wattage to 185w while running at 100 percent all-core load, and the temps went straight to 95 degrees (the Ryzen 7000's maximum by design), where it stayed regardless of fan or pump speed, and prevented the CPU from reaching its peak Turbo frequency. This means – in its 240mm configuration at least – that it's not a good choice for a high TDP CPU.

But, it is very quiet, and that's a huge plus. The pump noise is virtually

imperceptible, even at the highest RPM setting. The twin fans do make themselves known at the top speed setting, and as we've seen with testing this cooler, running them at top speed might be a necessity, depending on your CPU. It's a very capable design though, and long-term use in the Quiet mode is definitely achievable as long as your CPU isn't bumping up against its own thermal throttling limit. If silence is a priority, there's a Zero RPM mode which turns the fans off completely if the CPU isn't loaded.

Assembly and installation went well. Credit to Corsair for a generous tubing length. You won't likely be constrained by this and should be able to place the cooler in any part of your case and still have it reach the CPU comfortably.

The H100i Elite LCD XT improves on a well-proven design, adding loads of fancy lighting and very capable fans. Perhaps consider the 360mm version, though, if you're running a hot Intel i9 CPU.

A thermally and visually attractive option for mid-range CPUs.
Ben Mansill

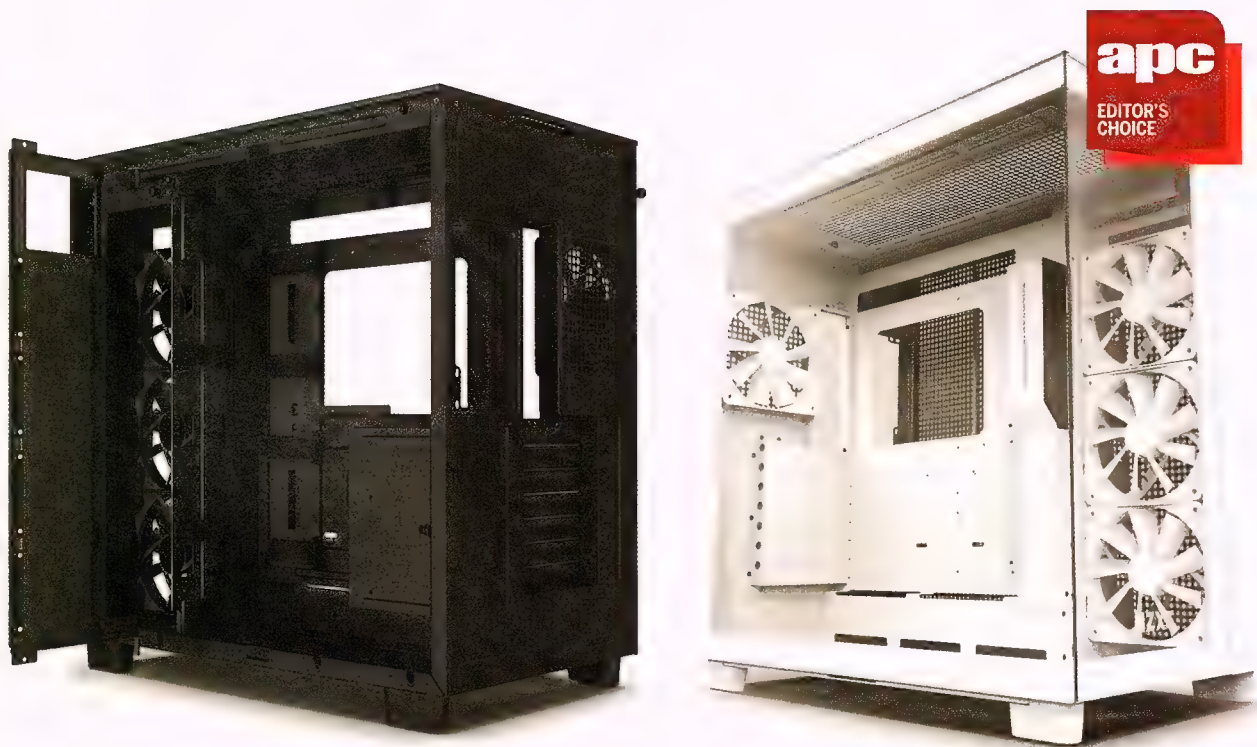
★★★★☆

CASE

Nzxt H9 Flow

A sleek looking chassis with the uninterrupted glass windows.

■ \$249 | nzxt.com/en-au



We were more than impressed by Nzxt's H7 range of cases last year, and the Flow variant was the one that took our fancy. It offered the best bang for your buck, maximising the potential performance of your build through its improved airflow while still retaining Nzxt's clean design aesthetic. But does the same apply to the slightly larger dual-chamber H9 mid-tower cases? At the time of writing, there isn't a standard edition of the H9, just the H9 Flow we have here and the more expensive range-topping H9 Elite. The latter costs \$100 more, so on paper, the Flow represents the better value for money, but is this the, er, case in the real world?

Compared with the H7 models we've already reviewed, the H9 has a deeper, wider, and taller design and also features two glass panels, which results in a see-through corner. This is one of the H9's stand-out features, differentiating it from the other models and setting it apart at the top of the tree. It's a great way to see all of your internals without the disruption from the typical metal corner you'd get on most cases. On the flip side, it's an extra incentive to get your cable management in check because you'll

see every untidy power and SATA lead.

Another stand-out feature is the dual chamber layout. There's almost a false wall where the motherboard fits. Behind this is a cavernous space with plenty of channels for cable management, a vertical shelf for the PSU, and a hinged door to further hide cables around the back. There's plenty of room in the rear, so you won't have to squeeze your PSU cables as much as you might on other slimmer cases. We know this can often be a pain and can cause issues when trying to shut the back panel.

Talking of panels, these are easy to remove, which seems to be fairly typical with Nzxt cases. The top panel pops off easily without requiring any tools, and both the front and back panels come off just by loosening a captive thumbscrew. Everything here feels durable and high quality. There are no alignment issues and each detachable part slots right back into place with ease.

Going back to the internals, there is so much room, enough for up to ten 120mm fans – that's a ridiculous amount of cooling, but perfect for those who need maximum airflow. Cooling combinations are plentiful

inside here too, with the ability to mount a 360mm radiator to the side, top, and bottom.

That slight gripe aside, there's not too much to fault here with this chassis. There's also a healthy selection of I/O ports, no fiddly front panel connectors for the motherboard, tons of room to build in, a variety of configuration options, and dependable and durable build quality.

Overall, this Nzxt H9 Flow is a fantastic package, certainly when compared with its more expensive sibling, the Elite. However, that case comes with a top glass panel for those who prefer a full glasshouse design. On the other hand, the Flow variant offers much greater airflow to keep your system cool, especially with the potential of up to ten 120mm fans – all for \$100 less. That's a significant price difference and you're getting all that you'll need here with this case.

Great ease of use with a dual-chamber design and lots of internal room.

Sam Lewis

★★★★★

SMARTPHONE

Samsung Galaxy S23

The most basic Galaxy S23 phone remains a fine choice, but it's expensive when compared to rivals.

■ \$1,349 (128/8GB), \$1,449 (256/8GB), | samsung.com/au

The S23 is the cheapest of the three phones in the new series, with Samsung charging \$1,349 for the 8GB version which includes a 128GB SSD. 256GB is available, though if you want 512GB, you'll need the S23+ (see opposite).

This buys you a larger screen and battery, but otherwise the phones are essentially the same. That includes the overclocked version of Qualcomm's Snapdragon 8 Gen 2 platform, and even with 8GB of RAM it massacres Gen 1 chips. It returned 1,522 and 4,876 in Geekbench 5's single-core and multicore test, which is about 40 percent faster than a typical Gen 1 phone.

The Adreno 840 graphics chip will keep any game at 60fps or above, and games that support it should happily run at the screen's peak refresh rate of 120Hz. The dynamic refresh rate ranges from 48Hz to 120Hz, with the OS clever enough to detect when it needs to boost.

It's a lovely display, based on Samsung's AMOLED technology, even if it's essentially unchanged from the Galaxy S22. Because it squeezes the same number of pixels into a tighter space, the Galaxy S23

■ 8-core (3.36GHz/3GHz/1.8GHz) Qualcomm Snapdragon 8 Gen 2 SoC; 8GB RAM; Adreno 740 graphics; 5G; triple 50MP/10MP/12MP rear cameras; 12MP front camera; Wi-Fi 6E; Bluetooth 5.3; NFC; USB-C 3.2 Gen 2 connector; Android 13 with One UI 5.1; 1yr warranty. S23: 6.1in 120Hz AMOLED screen, 1,080 x 2,340 resolution; 128GB/256GB storage; 3,900mAh battery; 71 x 7.6 x 146mm (WDH); 168g.

even beat the S23+ on pixels per inch: 425ppi vs 393ppi. Samsung claims it can hit 1,750cd/m², but the 1,002cd/m² we measured in SDR mode only increased to 1,340cd/m² with HDR active.

There's no charger in the box, but if you have a 25W charger to hand then the S23 goes from zero to 55 percent in 30 minutes. If you want faster 45W charging then you'll need to buy the S23+ or Ultra.

The S23 is a slender 7.6mm thick, and by milling away the raised contour metal surrounding the phone's three cameras Samsung has created a cleaner and more appealing look than the S22. Meanwhile, the slightly curved stainless-steel-looking aluminium band gives the phone a retro aesthetic that harkens back to

the Galaxy series' humble beginnings.

That chiselling away of the contour makes the S23's cameras look larger, but these are the same sensors as in the S22 and the S23+. As such, all the comments in that review hold here

too, right down to the upgraded 12MP camera integrated into the display. The S23 shares its siblings' build quality and IP68 rating, too, including the brushed Gorilla Glass Victus 2 on the back and the glossy

"It's a lovely display, based on Samsung's AMOLED technology, even if it's essentially unchanged from the Galaxy S22."

version of Victus 2 covering the screen.

For the first time, some external portions of the device are made, in part, from recycled materials. These include the volume and power buttons and the speaker grille at the top of the display. In addition, Gorilla Glass Victus 2 includes some recycled glass. Even the plastic cover you'll peel off the screen is partially recycled. There's still a physical SIM slot, but the entire Galaxy S23 lineup offers eSIM support, too.

Seen in a vacuum, the Samsung Galaxy S23 is an excellent Android handset. It has a stellar screen, great cameras and the cleanest design of any Galaxy phone in recent memory. Its biggest challenge is the price Samsung is asking for the privilege, especially when you consider the lack of radical leaps forward compared to the S22. I would be much more positive if Samsung had found a way to squeeze in a 10x optical zoom and a 108MP sensor. It's still a great choice if you want cutting-edge performance, but the Pixel 7 Pro beats it for value.

The more basic Galaxy S23 phones remain a fine choice, but they're expensive when compared to rivals.

Lance Ulanoff

★★★★☆



SMARTPHONE

Samsung Galaxy S23+

A brighter display, longer battery life and fine trio of cameras add up to a great, if iterative, update.

■ \$1,649 (256/8GB), \$1,849 (512/8GB) | samsung.com/au

It's hard to pick up the Samsung Galaxy S23+ and not suffer Ultra envy. There's no headline-grabbing 200MP camera, built-in S Pen or crazy 100x Space Zoom. If, however, you're looking for a big-screen flagship phone then the S23+ makes a fine argument for space in your pocket.

I was immediately struck by its build quality. The S23+ is solid with a comfortable heft at 196g, and I've little doubt it will survive a tumble or two. Some of my confidence stems from the use of Gorilla Glass Victus 2 for the screen and glass rear, while the IP68 rating means the phone can survive up to 1.5m underwater for 30 minutes.

The S23+ comes in black, cream, lavender and green. I was taken by the latter's dark forest vibe, adding to this phone's clean and sophisticated look. But it's the AMOLED screen, which reaches a peak brightness of 1,345cd/m2, that really grabs the eye. It's so vibrant – particularly in Vivid mode – that it's almost dazzling.

At 6.6in, the Galaxy S23+ strikes a nice balance between the smaller Galaxy S23 (6.1in) and the huge S23 Ultra (6.8in). This didn't hurt the S23+ in our battery tests. It includes a 4,700mAh unit, up from 4,500mAh in the Galaxy S22+, and coupled with the more efficient Snapdragon 8 Gen 2 silicon it lasted a superb 11hrs 24mins of continuous web surfing (with the screen set at 150cd/m2).

The camera features the same setup as the S22+ (and S23), with a 50MP main sensor, 12MP ultrawide camera and 10MP telephoto with 3x optical zoom. This combo lacks the wow factor of the Ultra, but it still produces excellent shots. For me, the S23+ beats the iPhone 14 Pro for colours, exposure and focus; the iPhone's results look almost drab in comparison.

It's only portraits where the S23+ falters, applying too much face

"Samsung currently has the best update policy in the Android world, with four years of platform updates and five years of security patches."

smoothing and saturation in its attempt to hide blemishes. The result looks artificial compared to the iPhone 14 Pro. I would also give Apple's phone the nod in low-light conditions, where it produces more vibrant colours.

Geekbench 5 tests, but I'm more interested in the fact that Qualcomm's Adreno 740 GPU outmuscles the A16 Bionic in 3DMark Wild Life.

As with the S23 Ultra, the S23+ includes Android 13 with One UI 5.1.

All the S23 series phone use the same Snapdragon 8 Gen 2 chip, with its primary core overclocked, and it produced excellent scores in our benchmarks. The S23+ still trails the iPhone 14 Pro in both single-core and multicore

Here, the Bixby Text Call grabbed my attention, where Samsung's virtual assistant answer phone calls for you with text messages. These messages are converted into audio for the caller, similar to how Google's Call Screen works.

Finally, let's talk updates. Samsung currently has the best update policy in the Android world, with four years of platform updates and five years of security patches. Having an up-to-date and secure device is extremely important, so I applaud Samsung for going for the sustainability route and helping people save money.

The Galaxy S23+ is one of the best Android phones around. The cameras, display and battery life are all top-notch, and the graphics performance exceptional.

As good as this phone is, it's hard not to have your head turned by the Galaxy S23 Ultra.

Jordan Palmer

★★★★☆



■ 8-core (3.36GHz/3GHz/1.8GHz) Qualcomm Snapdragon 8 Gen 2 SoC; 8GB RAM; Adreno 740 graphics; 5G; triple 50MP/10MP/12MP rear cameras; 12MP front camera; Wi-Fi 6E; Bluetooth 5.3; NFC; USB-C 3.2 Gen 2 connector; 6.6in 120Hz AMOLED screen, 1,080 x 2,340 resolution; 256GB/512GB storage; 4,700mAh battery; 76 x 7.6 x 15.8mm (WDH); 196g; Android 13 with One UI 5.1; 1yr warranty.

Windows 10 or 11 | files.community/download

FILES 2.4

File manager

Microsoft has finally added tabs to File Explorer in Windows 11, but the feature has long been offered by this fantastic open-source file manager. Files may have a hard-to-Google name, but it's packed with useful options you won't find in File Explorer and the latest update adds even more.

Files already benefits from a simple, modern interface and version 2.4 lets you tailor it to your needs by changing the default layout. Click the Layout button on the toolbar and choose your preferred style, such as Details (which tells you the date your files were last modified as well as their type and size), Tiles (which displays thumbnail icons for each file) and Adaptive (which adjusts the layout to suit the content you're viewing).

You can also now change the way

Files sorts and groups items in folders. Click the Sort button and choose to organise your files by name, size, type, date created or date modified, and whether to list them in ascending or descending order.

Another welcome addition is the ability to view storage information by hovering your cursor over a drive or partition. This tells you at a glance the amount of used and free space, as well as the total capacity of the drive.

However, the biggest improvement in Files 2.4 relates to how it handles compressed archives such as ZIP files. A new Extract option appears

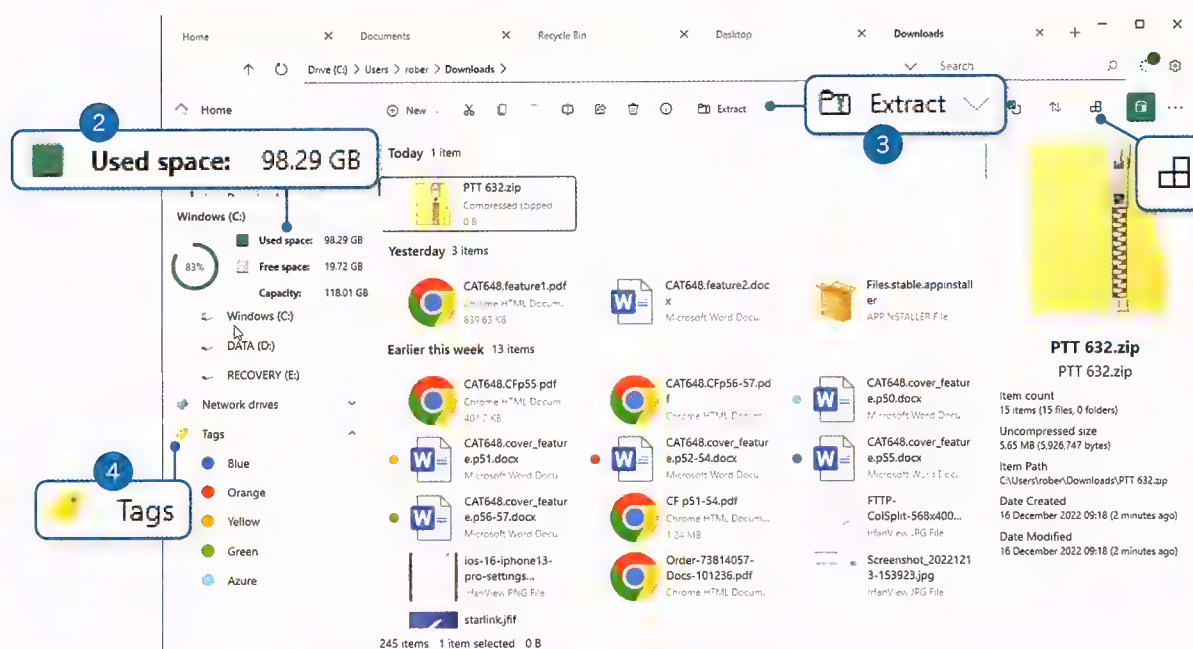
on the main toolbar when you select an archive, which lets you extract its contents to either the current folder, one you specify or a new

folder with the same name as the archive. Equally handy is the new option to create your own compressed archives by right-clicking a folder and selecting Archive then 'Create archive' – you can choose between ZIP and 7Z formats.

When you visit the official website at

the link we've provided, click Sideload to download Files for free – if you get the app from the Microsoft Store, it costs \$9.99.

"Files may have a hard-to-Google name, but it's packed with useful options you won't find in File Explorer and the latest update adds even more."



1 You can now set a default layout for Files to suit your file-management needs. In our screenshot, we've chosen Tiles, but other options include Details, Grid View and Adaptive. Click the Layout button to switch.

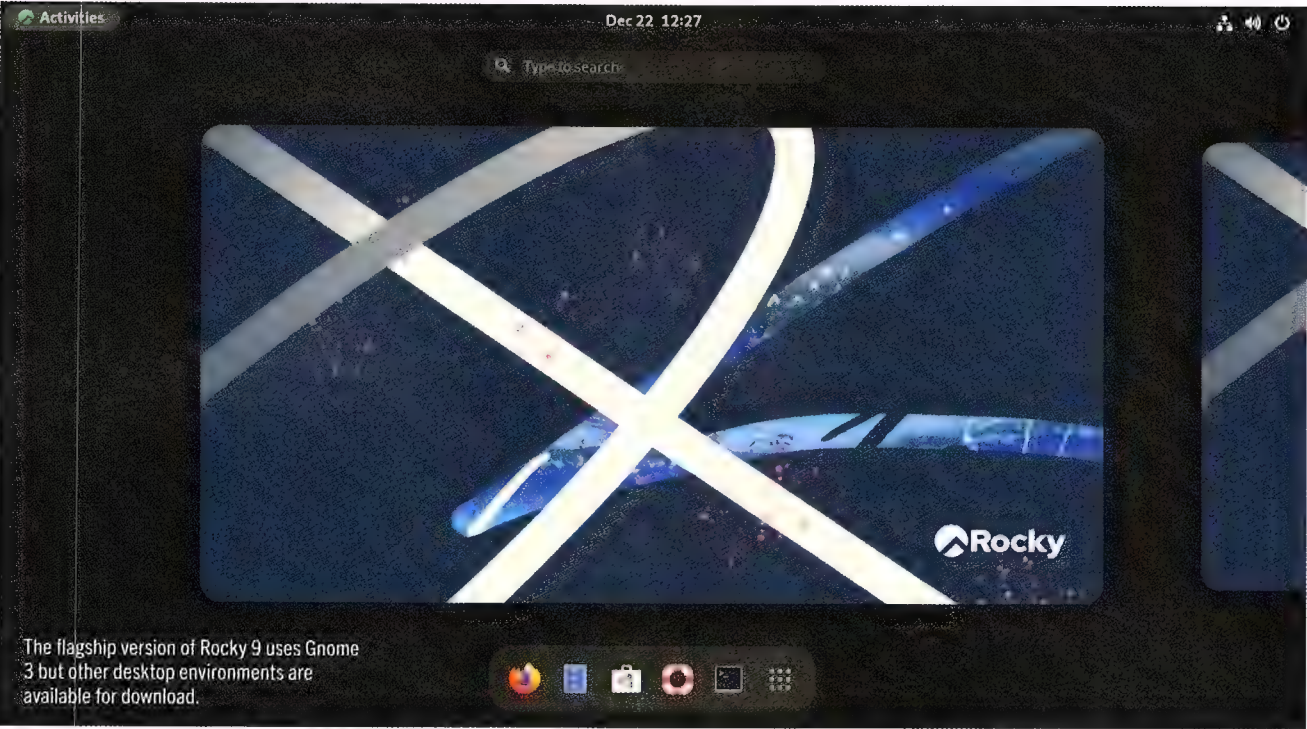
2 When you need to see how much storage space is available on a drive, hover your cursor over it and Files will tell you the amount of free and used space. This saves you having to right-click and choose Properties.

3 To access the contents of a compressed archive, select it and an Extract button will appear on the main Files toolbar. This lets you extract files to the current location, browse to a different folder or create a new one.

4 Another useful feature in Files lets you label your files with different coloured tags. Right-click an item, choose 'Edit file tags' and select a colour. Click a tag to view all the files you've labelled with that colour.

ROCKY 9.1

Nate Drake goes head to head with Red Hat-based distros this month, so is glad to have the heavyweight Rocky in his corner.



We're usually very into Debian-based Linux, here at APC, but don't want you to think that we've anything against RPM distros. One of the best known is Red Hat Enterprise Linux (RHEL), a commercial version of Linux.

This may sound counterintuitive, as the whole ethos of Linux is one of free and open source software. Red Hat does make its source code publicly available but also sells subscriptions and training. Other developers can use RHEL's source code to make their own distros, as is the case with Rocky 9.1

Rocky Linux was originally pioneered by one of the founders of CentOS, Gregory Kurtzer. After Red Hat announced last year that it wouldn't continue development of CentOS, the community-supported free version of RHEL, the team at Rocky stepped up to create this binary compatible release.

The most recent result, Rocky 9.1 Blue Onyx, is an extremely reliable OS. Being based on RHEL means that it has been checked thoroughly to make sure it's stable and functional. In the release notes, the team states this version went through nine days of testing, carefully documented on the website. In theory, this means you're benefiting from effectively the same OS for which others are paying, with support until 2032.

In the nature of things, though, this means there's a colossal number of packages available. The regular install DVD weighed in at over 9GB but there are various download options, including via BitTorrent. You can also choose to download the 1.5GB Minimal ISO, then install the GUI and other packages via the command line, as we did. This is all helpfully explained in the Rocky Linux online documentation.

Sadly, there's no way to test Rocky in Live mode but setup itself is a breeze. The installer gently guides you to choose your username, time zone and target drive using a simple GUI. We were also very impressed that setup makes you set a root password, as this stops bad actors from trying to do this post-install.

When your desktop loads for the first time, setup also prompts you to connect your online accounts and set your own username and password. You're then treated to a whistle-stop tour of the Gnome 3 desktop. The Gnome Software Centre is just as easily able to install RPM programs, among which you find favourites such as the Thunderbird email client if you want an alternative to the pre-installed Evolution. The VLC media player is notably absent by default but you can add this and other programs

by enabling community-based repos such as EPEL (Extra Packages for Enterprise Linux) and RPM Fusion, then installing via the command line. If Gnome 3 isn't to your taste, the Rocky Linux website also offers ISOs with the Gnome Lite, KDE, Xfce and MATE desktop environments.

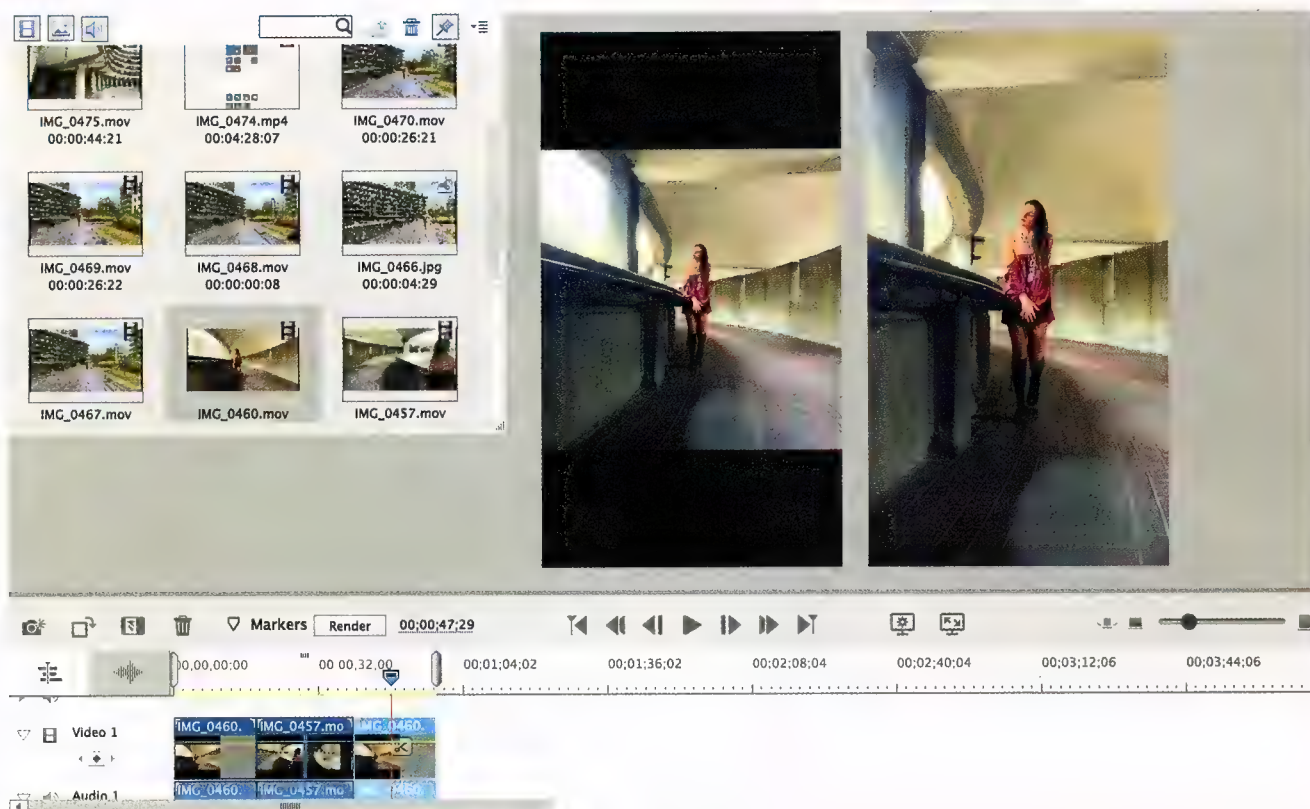
Since CentOS was axed, Rocky Linux has gone from strength to strength. According to EPEL stats, it's the most popular distro of this kind. In a Reddit chat last year, the Rocky team said this may be because the community is much larger than that behind CentOS. The devs have also released the open source build stack Peridot, so anyone can build new versions of the OS and it's very unlikely to share CentOS's fate.

This should make your decision whether or not to switch to Rocky very simple: if you want to benefit from the stability and support of Red Hat Linux without the price tag, the people have spoken. Rocky offers the same functionality, is easy to set up and has a huge amount of online support.

If you're a Red Hat fanatic, Rocky is an ideal OS to set up and use, with easy installation and good online support.

Nate Drake

★★★★☆



macOS 11, macOS 12 (12.4 or later), Windows | \$145.19 | adobe.com

ADOBE PREMIERE ELEMENTS 2023

Turn raw footage into slick stories for your social media feeds

As a simplified version of Adobe's Premiere Pro software, Premiere Elements 2023 is an entry-level non-linear (NLE) editing app that's designed to help video makers edit, fix and share their video footage as polished programmes, complete with post-production assets such as titles and transitions. It also enables you to add creative effects to your clips to

make them look more eye-catching, which should make the app attractive to creators of social media content.

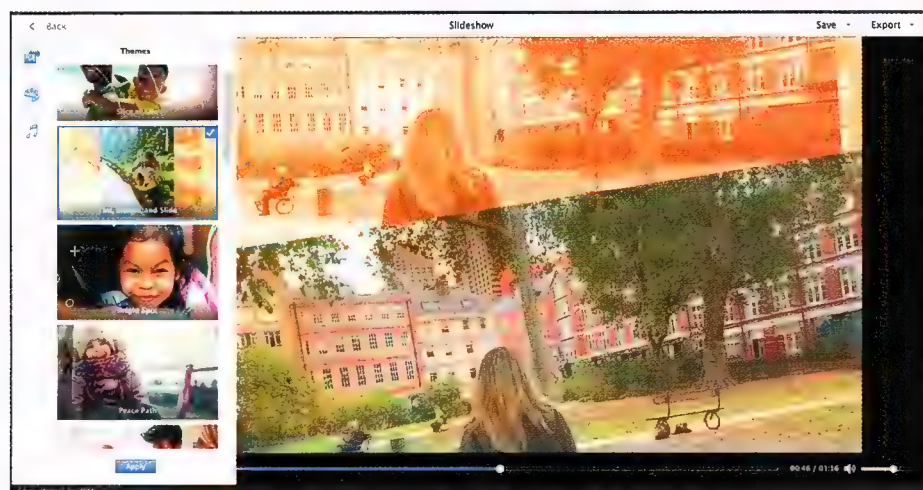
Premiere Elements 2023 has many social-media friendly properties. For example, if you shoot video with your iPhone held horizontally, you'll capture a horizontal 16:9 clip. However, if you want to add the footage to a

Above: The Auto Reframe tool in the timeline enables you to automatically preserve key people when cropping a horizontal clip to fit a vertical frame.

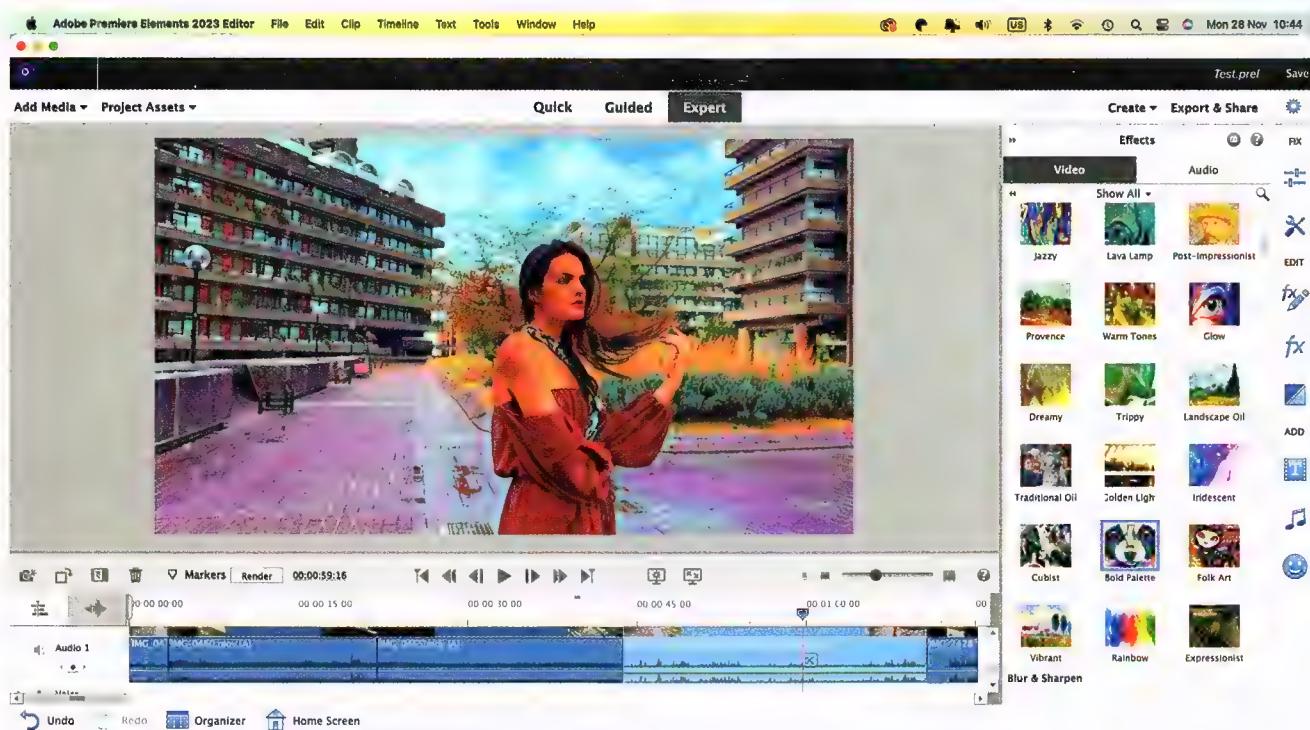
vertically-oriented Instagram Story, the edges of the clip will be cropped and your key subject could be lost. Premiere Element 2023's Auto Reframe tool can automatically crop and recompose the clip to fit the vertical shape of an Instagram Story (and it is intelligent enough to reposition people in the middle of the frame so that they are always visible).

If you're already using Photoshop Elements, Premiere Elements 2023 will slot nicely into your organising, editing and sharing workflow. Premiere Elements 2023's accompanying Organiser uses Adobe Sensei Artificial Intelligence technology to analyse the content of your clips as well as your stills. It then adds Smart Tags that cover common subjects such as sunsets, dogs, cats and so on.

Premiere Elements 2023's Organiser can also recognise faces in your footage, so you can find clips that feature particular people more quickly. Once you launch Premiere Elements 2023 from the Elements Organiser, you're presented with three



In the Elements 2023 Organiser, you can export video clips as slideshows featuring new and contemporary animated graphical components.



workspaces – Quick, Guided and Expert. The Quick workspace is a good place to trim single clips or stitch a few shots together in the timeline before sharing them as a short sequence. You can also add titles and transitions here.

Guided edits

The novice video editor might be wise to start with the Guided workspace. Here, 27 themed Guided Edits walk you through the video production process – from the basic tasks of importing, reordering and trimming clips in the timeline to adding post-production graphical elements such as captions to spruce up your social media posts. In the Guided workspace, step-by-step text instructions are accompanied by pop-up highlights around various buttons and panels, so you can quickly learn how to find and use key editing tools.

After spending time trying the techniques in the Guided Edits, you'll become confident enough to explore the Expert workspace. This looks similar to other non-linear video editing apps such as iMovie with a timeline along the bottom, a bin full of project assets at the left and the edited programme displayed in the viewer. Extra tools, such as filter effects, can be summoned by clicking icons on the right. Unlike the Quick workspace you can add video and audio content to multiple tracks to combine

footage in more creative ways.

During our test Premiere Elements 2023 was happy to import and edit a range of different clip sizes and formats from our iPhone 14 Pro Max (including footage shot in ProRes). However, you can only adjust a Cinematic mode clip's blur effects using iMovie and Final Cut Pro's specialist tools.

Compared to Apple's entry-level video-editing app iMovie, Premiere Elements 2023 boasts a more sophisticated set of post-production tools, such as the ability to make selective adjustments to the colours and tones of a bright sky without changing a landscape's darker exposure, for example. iMovie only lets you apply one effect filter at a time; Premiere Elements 2023 enables you to apply multiple filter layers that give you more freedom to experiment with a range of creative looks. You can adjust the properties of each filter layer to blend it with the colours and tones of the original clip.

What's new?

The latest version of Premiere Elements boasts new Adobe Sensei-powered artistic effects that help your footage resemble the work of classic artists (such as Monet). These 24 new artistic effects are a welcome alternative to the dated collection of FX filters in previous versions. Premiere Elements 2023 also

features new slideshow templates that enable you to present a mix of clips and stills in eye-catching social media presentations (though you have to access these via the Elements

Organiser app's Create menu). These slideshows feature animated graphic assets and layouts that you can experiment with to make your social media posts stand out. Premiere Elements 2023 has been optimised to take advantage of new hardware so you should experience 70 percent faster launch times and performance on Apple silicon Macs.

You can download a trial version of Premiere Elements 2023 from adobe.com. This gives you 30 days of full access to the app, enabling you to discover the extra tools that iMovie lacks (such as Auto Reframe).

New Adobe Sensei-powered artistic effects enable you to turn your clips into animated paintings.

"Premiere Elements 2023 enables you to add creative effects to clips, which should make the app attractive to creators of social media content"

Adobe Premiere Elements 2023 guides video-editing novices through simple and then more sophisticated post-production techniques.

George Cairns

★★★★☆



MAKE IT WORK FOR YOU

The amazing new AI tools aren't just playthings, they can make a serious impact on your business. Barry Collins meets the people who've put AI to work for them.

Let's face facts: there's a decent chance AI will take your job. There's certainly a high risk it will swallow mine. But instead of fretting over whether AI will eventually put you out of work, how about getting it to work for you?

Although tools such as GPT-3 and Midjourney are still in their infancy, there are already people and industries putting them to professional use. The extraordinary capabilities we've all played with in services such as ChatGPT are being used to generate business leads, spark creativity and make serious money.

Better still, you don't need great coding skills to put these AI services to work. In the rare instance where you must use a bit of code, the AI can normally write it for you. All you

activism, writing a poem about giraffes in the style of William Shakespeare, or dreaming up names for a coffee shop in Paddington, there's little the AI won't have a decent stab at.

SEO expert Danny Richman wasn't interested in the frivolous uses of ChatGPT. He calculated that he could put that natural language ability to productive use for a variety of clients.

ChatGPT is the public-facing toolbox of OpenAI's GPT-3, the language model that uses deep learning to produce human-like text. What Richman realised was that, using other tools, such as the automation service Zapier, it's possible to create sophisticated workflows. For example, when an email arrives in an inbox, the AI can

simply writing emails back to customers on the landscaper's behalf, to help him win business. Then Richman worked out he could save both himself and the landscaper a lot of time by using GPT-3 to generate the replies.

Richman created a workflow that allowed the landscaper to send his proposed replies to customer emails to a dedicated Gmail account. He would then receive an email back, with both his original message and an AI-enhanced version of the reply written in a more professional style. For example, the landscaper might respond to a customer's email with: "Sally I am starts work at yours on Monday" and GPT-3 would convert that into: "Dear Sally, I hope this email finds you well. I am writing to let you know I will be starting work with you on Monday. I am looking forward to getting started."

It wasn't only replying to customer inquiries that Richman set up a script for, but preparing estimates and generating contracts. Within weeks of setting up the service for the landscaper – a process that took Richman less than 15 minutes – he'd landed a contract worth more than \$350,000.

When Richman shared details of how he'd used AI to help the

Below: AI is helping to spark creativity across a range of industries.



really need is the imagination to think of ways in which the AI can make your work life easier.

Here, we're going to speak with people who are using AI to make a big difference to their business. They're not using huge supercomputers or privately developed software, but the same publicly available tools that any of us could use at very low cost. AI might be a threat, but it's also a very real opportunity – one that's ready to be exploited today.

The language barrier

If there's one branch of AI that has astonished in recent months, it's the natural language ability of ChatGPT. Even when fed with the most basic of prompts, ChatGPT's ability to write fluent, coherent responses has been nothing short of revelatory. Whether it's chatting away inanely, delivering a speech on the impact of climate

AI MIGHT BE A THREAT, BUT IT'S ALSO A VERY REAL OPPORTUNITY — ONE THAT'S READY TO BE EXPLOITED TODAY

evaluate the content of that email and deliver an appropriate response (see "Getting started with GPT-3", p53).

Richman was mentoring a young landscape gardener who was struggling to respond to emails from customers because he suffers from dyslexia. At first, Richman was

Above: ChatGPT's ability to write coherent text has been revelatory.



landscaper on Twitter, it went viral, attracting almost 100,000 likes. Among those who saw it were OpenAI, who approached Richman to see if they could make his app more widely available for dyslexia sufferers. "I'm now working in collaboration with OpenAI and Zapier, and a company called Fhoke



who are branding and design experts that I've worked with for years," Richman told APC. "Everyone's working for free. And I reckon we should be good to launch at the beginning of April."

Laying down the law

It's not only GPT-3's ability to write natural language that makes it such a valuable business tool, but its ability to interpret what humans are writing.

One of Richman's other clients is a legal firm that provides defence counsel for people involved in criminal trials. After helping the firm with its SEO, the company's website receives around 400 inquiries a day from people who may potentially need legal representation. "We have people fill out a form on the website, and they describe everything that's happened up to the point where they've been arrested or charged," said Richman.

Until recently, that legal firm had a dedicated team of people who were monitoring that inbox. "The first thing they're trying to figure out is

DALL·E History Collections

Edit this detailed description

Create a pencil drawing of a mid-century French-style chair



AT THE END OF THE TWO MONTHS WE FOUND THAT THE AI WAS MORE ACCURATE AT THE ASSESSMENTS THAN THE HUMAN TEAM

whether they are the victim of a crime or accused of a crime, because some people don't understand what criminal defence is," said Richman.

"Then they're trying to figure out... what type of offence are they likely to be charged with? And then they're trying to work out the prospects of whether this is likely to go through to a court trial, which means it's a more serious case. [The reason] they want to know that is because a court trial means much higher fees for the law firm. And so, on the basis of that classification, they then categorise it as a high, medium or low-priority inquiry. And if it's a high-priority inquiry, they get back to that person within minutes to try to make sure they become a client. And so that process involves a lot of very qualified, very expensive people to go through all that and make that determination."

Or, at least, it did. Richman convinced the law firm to run a trial, using GPT-3 to analyse the incoming messages and make the exact same calls the human team was making. Is it a defence case? Have they been charged with a serious crime? Is it

likely to end up in court? "We ran that as a trial for two months against the human team, and at the end of that two months we found that the AI was more accurate at those assessments than the human team," said Richman. "The human team has now been disbanded and all of those people are now working on the cases rather than having to triage inquiries."

In terms of efficiency and cost saving, Richman said it's the single biggest AI project he's created. And it's entirely replicable. "Although that's very specific to one particular firm, that same process of managing leads would apply to so many businesses," he said. "With a very small adaptation, that could be a massive efficiency improvement for any number of businesses."

Generating inspiration

AI isn't only good with words. As we've all seen in recent months, services such as Midjourney and DALL-E 2 have amazed and amused the internet by allowing people to enter text prompts and get a selection of images back 30 seconds later. The results are variable – sometimes gobsmacking, sometimes looking like a smacked backside – but it's already becoming an invaluable resource for people in the creative industry.

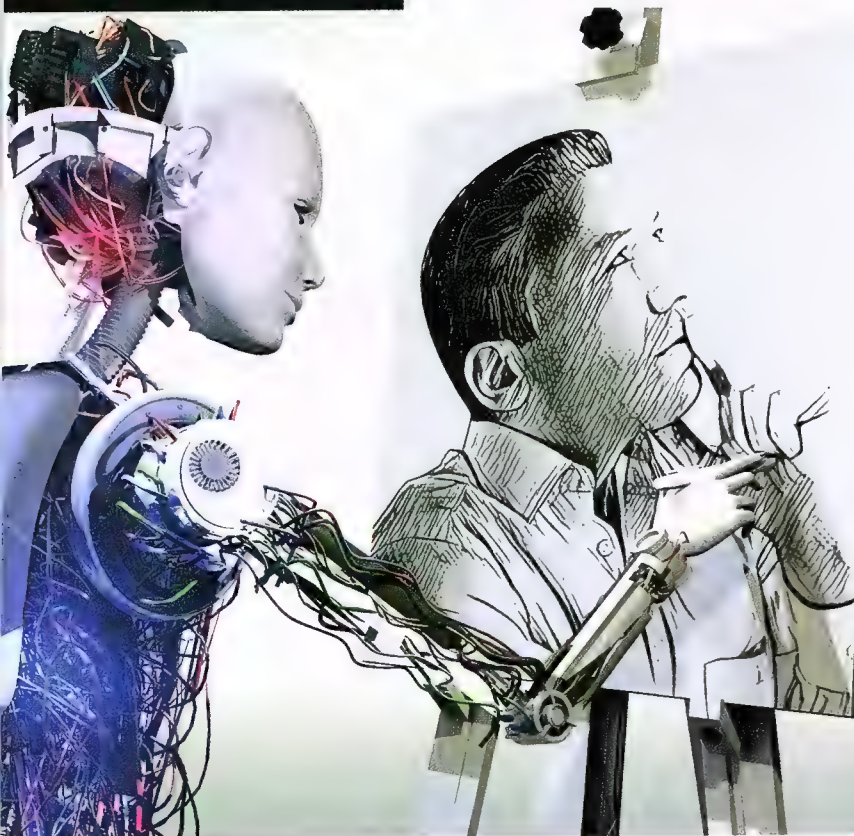
Ed Bolton is a creative director of brand at Frog, a creative consultancy and part of Capgemini Invent. His company is already making heavy use of such AI tools, particularly when it comes to brainstorming or finding inspiration for a graphic design. "Whereas before I would go on Google and say 'I want a picture of this' and it would take me hours to scroll through it, now I go 'I want a picture of this looking like this' and I get it instantly," said Bolton.

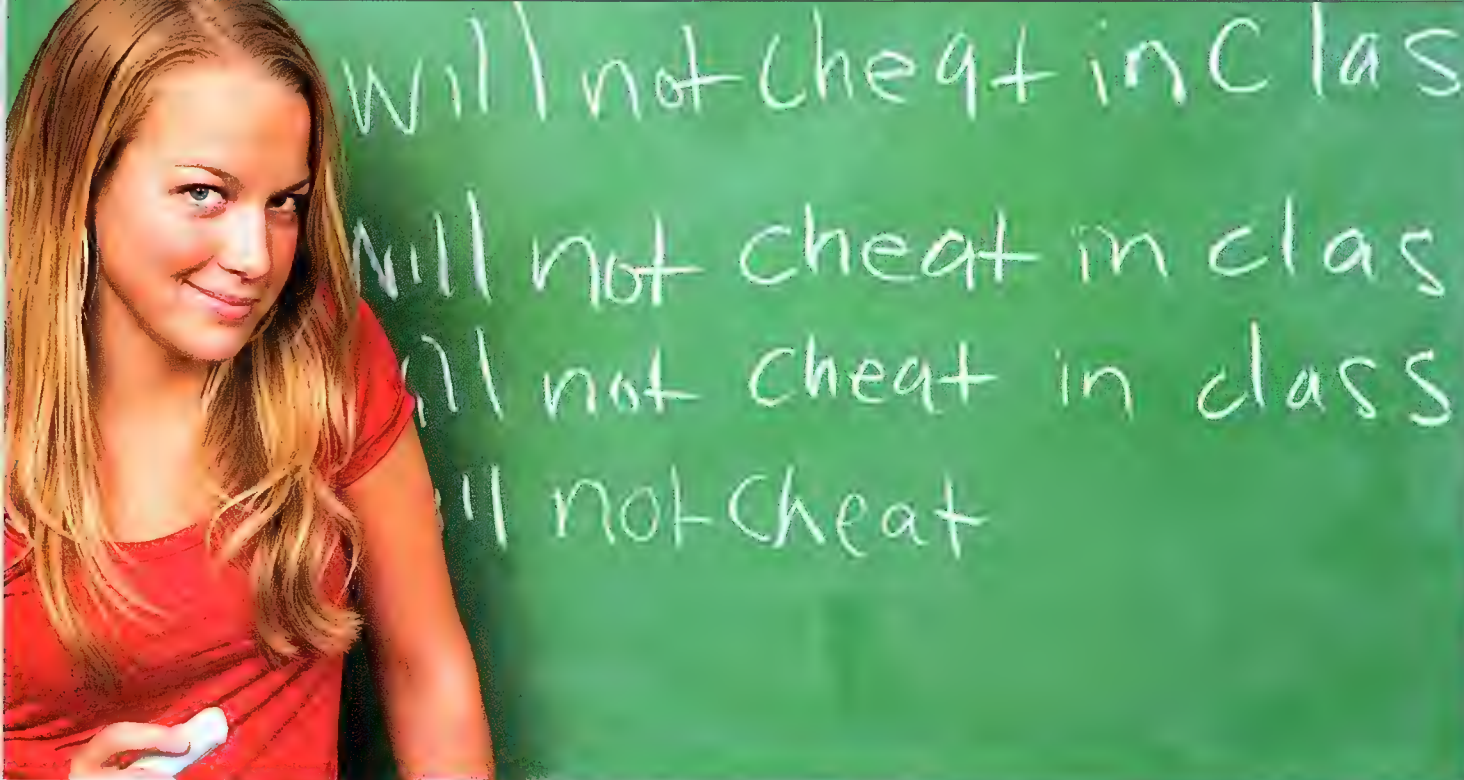
Getting the text prompt right in the first place is key to getting good results, according to Bolton. "There is an art to prompt engineering and it's not as simple as I'm making it sound, because you can use DALL-E and get loads of rubbish quite easily," he said. "But it lowers the barrier of entry really quickly. And I believe that amount of [saved] time will only allow creatives to spend more time creating, thinking about things, refining things, doing what we're meant to be doing."

It's not only creative agencies who are benefitting from ideas generated by AI. Bolton said he has a friend who is a furniture designer, who uses DALL-E to give him "inspiration for some weird and wonderful mid-century French-style chairs", for example. He won't build precisely what the AI spits out, but he may use ideas from different images in the design of his next piece of furniture.

Left/below left: Midjourney and DALL-E 2 allow you to enter text prompts and get a selection of images back, and are becoming an invaluable resource for people in the creative industry.

Below: AI-created artwork has been the subject of legal battles.





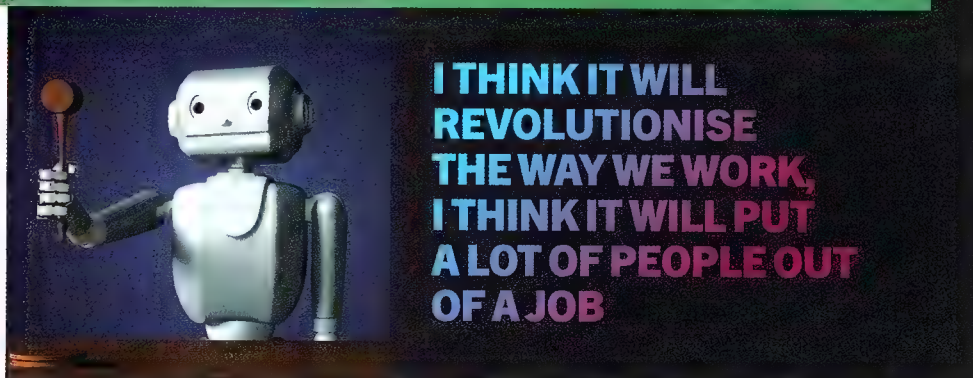
"I don't think we'll ever see there's not a need for creatives, but the level of inspiration will be increased, and I call it the age of limitless inspiration."

Yet, as much as Bolton insists there will always be a place for the human creatives, he concedes that the influx of AI tools into the industry will inevitably result in job losses. Indeed, he's already replaced human artists with AI for some tasks, such as storyboarding. "The current process would be you write the script, you get storyboard artists to draw it up frame by frame, you modify it, they modify it, and you come up with a rough-and-ready storyboard visualisation that you then take along to the shoot," he said.

Now, however, "you're cutting out the storyboard artist because you can use creative AI," said Bolton. "With a prompt such as 'sketch pen art', for example, you can create the right type of imagery. If what you get is imperfect first time, you can then keep playing with it."

Indeed, DALL-E's recent introduction of "outpainting" – extending the canvas beyond its current confines, in much the same way that Photoshop can paint in areas of a photo that aren't in the original frame – make storyboarding even easier. "That [outpainting] also increases how you can almost visualise the entire film, by always outpainting things and then cropping into them when you do the storyboard."

"So, essentially, I think it's killing the storyboard artist – which is quite a niche industry anyway," said Bolton. "You're still directing it, it's still your vision, but it's visualising it through DALL-E [rather than a human artist]."



Top: Despite media scares about AI cheating, ChatGPT has been welcomed by many educators.

Although Bolton is clearly a huge AI enthusiast, he's not blind to the potential impact this could have on people in his industry. "I think it's an amazing tool, I think it will revolutionise the way we work, I think it will put a lot of people out of a job," he said. "You don't need so many PowerPoint designers. You don't need so many people writing content if this thing can do it immediately for you. But it's not perfect and I don't think it will ever be. I think humans and creators need to layer their own creativity on top to get the best result. And I think because of the increase in time [afforded by AI tools] we'll be able to do it with more emotion, more soul, more empathy."

"It's ironic that the machines are allowing us to do that," he added.

The AI battles ahead

Aside from AI's rather ominous ability to cut through swathes of human jobs, there are other downsides to what seems like the relentless – and now rather rapid – march of AI tools in the workplace.

The legal complications are already beginning to arise. For example, the renowned photo agency, Getty Images, is suing the

creators of Stable Diffusion for alleged copyright violation. Getty claims that Stability AI "unlawfully copied and processed millions of images protected by copyright" in what could soon become a test case for training AI on material gathered over the internet. Getty claims it's not anti-AI, but that Stability AI failed to license the images that it used to train Stable Diffusion – something the AI firm can hardly deny, given that Getty Images watermarks have appeared in results delivered by the service. "Stability AI did not seek any such licence from Getty Images and instead, we believe, chose to ignore viable licensing options and long-standing legal protections in pursuit of their standalone commercial interests," Getty said in a statement.

When approached by APC, a Stability AI spokesperson said: "We take these matters seriously. We are reviewing the documents and will respond accordingly."

The legal uncertainty is one of the reasons Ed Bolton is reluctant to include any artwork generated by AI in the final package delivered to his clients. "I wouldn't do that," he said. "I think that would definitely have to be a legal conversation, because we're obviously extremely conscious about the ownership rights of the stuff we

create for our clients.”

On the flip side of the coin, artists are now finding they are being denied copyright because they’ve used AI in the process of making works. Kristina Kashtanova was last year granted copyright for her graphic novel *Zarya of the Dawn*, which was subsequently cancelled by the US Copyright Office because she used Midjourney to create some of the images in the book.

In an open letter, her lawyers argued that a Supreme Court ruling had determined that only “a modicum of creativity” was necessary for a work to be copyrightable, and that the constant iteration of images by refining the text prompts given to Midjourney was an act of creativity in itself. “Each of the hundreds of intermediate images used to produce a final image required the composition of inputs and prompts, followed by one or more selections to use in the next iteration,” argued Van Lindberg of Taylor English Duma, LLP.

“The Copyright Act does not dictate that an author’s creative input be provided in a particular form or that an artist use a particular tool. So long as the creative output is fixed into a tangible medium of expression, any tool that allows the author’s creative expression to ‘be perceived, reproduced, or otherwise communicated’ is eligible for copyright. This includes works created by using the Midjourney service.”

Yet, if there’s any industry that’s preoccupied with AI being used for “cheating”, it’s education. Ever since ChatGPT put these enormously sophisticated writing tools within the reach of students, the media has been obsessed with stories about AI being used to cheat on assignments and exams. However, there are also those in the teaching profession who are more relaxed about the use of AI in the classroom, encouraging their pupils to embrace AI tools because they iron out some of the disadvantages that are inherent in the education system.

“ChatGPT levels the playing field,” wrote Ethan Mollick, a professor at the Wharton School of the University of Pennsylvania, in a Substack post. “Everyone can now produce credible writing. While this is a problem for writing classes (which will likely have to return to blue books and longhand essays), it isn’t in my particular context, so I am suggesting students use AI to ensure their writing is of high quality. In fact, I now expect to see only high-quality written work, since there is no longer an excuse.”

It comes back to what Ed Bolton said about using AI tools to handle some of the grunt work, freeing students’ time to pursue other things. “Ultimately, I am increasing the amount I expect students to accomplish, thanks to AI,” Mollick wrote. “As one example, it was once rare for students to have a product demo completed in six weeks – now I can require it, thanks to the boosts to coding and image creation provided by ChatGPT and Stable Diffusion. Other assignments are similarly being adjusted to take into account how much more students can do. This means we can cover more advanced topics in a [sic] introductory course than I thought possible two months ago.”

If today’s students are putting AI to work in the classroom, it seems inevitable that future workplaces are going to benefit from those AI skills, too. If you don’t want the AI eyeing up your job, it’s time to work out how you can get it working for you.

Getting started with GPT-3

You’ve probably spent more time than you should toying with ChatGPT, but the GPT-3 engine behind it is a paid-for tool that offers a lot more flexibility, especially when it comes to writing apps and training the AI with your own data.

We don’t have the space to do a deep dive into GPT-3 here, but if you want to start exploring what this enormously powerful tool has to offer, you should start experimenting in OpenAI’s Playground.

The first thing to do is visit openai.com/api and sign up for an account. You can sign in with your Google or Microsoft credentials or register afresh with an email account. You’ll get US\$18 of free credit to play with, but you’ll need to enter payment details to start doing any serious experimentation. We’ll come back to controlling costs in a bit.

OpenAI provides a lot of great documentation and examples that it’s worth working through once you’re registered. However, the Playground (beta.openai.com/playground) is the place to start cutting your teeth.

There’s an enormous amount to play with here, but perhaps start by using the preset dropdown at the top of the screen and selecting one of the options. For example, “natural language to Python” is a preset that allows you to type what you want a piece of Python code to do and let the AI do the coding. Or, under “more examples”, try “Ad from product description” which could help you sell an item on eBay by

providing basic product details. There are at least 30 different examples to choose from.

On the right of the Playground screen are various parameters to play with. Again, we don’t have space to dive into them all here, but you can choose which language model you use (Davinci-003 is the most advanced, but also the most costly), while turning up the temperature allows the AI to be more creative in the answers it gives, but runs a greater risk of random or nonsense output. Again, read the documentation to find out what they all do.

Pay particular attention to tokens. Tokens are how OpenAI charges for the service. Tokens basically equate to the length of the output provided, so if you’re asking the AI to produce reams and reams of text, it’s going to cost a lot more than one-word answers. You can adjust the maximum length to keep costs down.

To ensure you don’t accidentally run up a massive bill (which is more of a risk when you’re running apps against

the API), you can put a soft and hard cap on your monthly bills in settings. Click on your profile in the top-right of the Playground screen and select Manage Account | Billing | Usage Limits. Set a low limit until you’re comfortable with how it’s charged. It will probably work out a lot cheaper than you fear, but it’s better to play safe to start with.

If your app suddenly stops working, go back into billing and check you’ve not hit the cap. ■

IF YOU WANT
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WHAT THIS
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Intended for FPS games, the Razer Tartarus Pro can also be pretty handy for apps that use many macros.

Unusual inputs

Bennett Ring examines I/O that makes you go huh?

Elon might be working on a direct neural interface between man and machine, but until he delivers something that won't fry our brains, we're stuck with using our clumsy physical bodies to get our computers to do what we want. For most of us, that means the humble mouse and keyboard combo. We thought it a little odd that we're still interacting with billions of AI-enhanced transistors via a finger pushing board that has its origins in the typewriters of the 1800s, so we scoured far and wide to see what other options we have.

Microsoft Ergonomic Keyboard

Whether you're a student in primary school, or an accountant filling out spreadsheets all day, you've probably wondered if there's a better way to input characters onto a screen. We present to you, the ergonomic

keyboard, which splits the island of characters down the middle into two sets of keys, then angles them to better match the natural resting state of our arms. We've used them, they rock, they make typing so much comfier, so we're not sure why they're not the dominant form of keyboard life. This version from Microsoft was one of the first, but they're now made by most keyboard makers.

Logitech Vertical and Lift

Apart from the fact they aren't made of wood, today's computer mice don't look too dissimilar to the large timber puck invented by DARPA in the early 1970s. Thank goodness a few ergonomic engineers thought about how to improve them, leading today's vertical mice like the Vertical and Lift models from Logitech. The change over a normal mouse is ridiculously simple

— just rotate the hand support so that we don't need to twist our wrists 90 degrees to use them. Again, we have no idea why these aren't the norm, as we were able to adapt to the comfier new position of the Vertical in a matter of hours. Do yourself a favour, pick up an ergo keyboard and mouse, pronto!

Razer Tartarus Pro

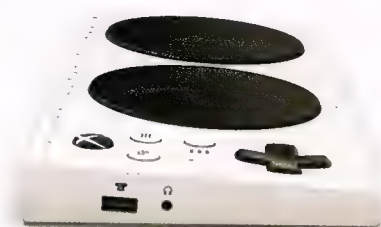
When you're in the thick of a duel in the latest Battlefield game, the last thing you want is to accidentally hit the T key instead of the R. Let's face it, a device used to write university essays probably isn't the best input device for your FPS shenanigans, and we've often wondered why there isn't a better solution. The Tartarus Pro is not a device for getting plaque off your teeth, it's actually a mini-keyboard with a thumbstick, and was the inspiration for this article. After 30 years of using WASD to pwn the noobs,



We've long admired Logitech's Vertical mouse. For those with mouse-related shoulder pain it's a winner.



The Quadstick allows full use of a PC for those unable to use their hands.



Microsoft did a great job with its Xbox Adaptive Controller design.



Left: PointCTRL is a device that senses individual finger movement within a VR environment. Below: Leap Motion is still at it, trying to perfect its virtual hands device.

we have to admit that this I/O gadget didn't feel as immediately natural as the less bizarre ergonomic devices. It's arguably not as good for FPS games, where split second movement is required, but for something like an ARPG or MMO, we think this'll do a mighty fine job. Our biggest concern though is the lack of keys, as you just can't beat the 101 or so keys on a keyboard – so Razer, can you make an XXL version of this, or perhaps a standard keyboard with the Tartarus Pro built into the left side? Thanks Razer.

Leap Motion

We remember testing this hand-sensing camera back in 2013, and were marvelled and disappointed at the same time. This little box of magic incorporates two IR cameras and some LED lights that allow it to see your hand movements within a range of about a meter. We marvelled at watching the on-screen skeleton hand mirror our real life digits, but were disappointed at the absolutely dismal uptake of software support for this thing. The lack of things to do with it saw Leap's company value drop from US\$300m to a mere US\$30m, but Leap soldiered on, and it looks like the uptake of VR could be its saviour. DIY virtual enthusiasts have been strapping the Motion to the bottom of their HMD for years now, allowing them to touch their VR chat buddies in the most inappropriate places without getting their controller dirty.

"Apart from the fact they aren't made of wood, today's computer mice don't look too dissimilar to the large timber puck invented by DARPA in the early 1970s."

Xbox Adaptive Controller

Microsoft has been leading the charge to make gaming more accessible to those of us who might struggle to use a control pad to shoot you in the knee, and its Adaptive Controller has received widespread acclaim for opening up gaming. Looking like a set of turntables you might see at a local rave party, it turns out the two big black circles are just buttons – we were kind of hoping they would allow

directional input. However, if one player's mobility is limited to the point where they are only able to hit these big buttons, it can be paired with another player using a standard controller, who handles direction.

Quadstick

If you don't have the ability to use anything other than your mouth for gaming, you might feel like you're going to be limited to taking a backseat ride, watching your pals have all the fun. Turns out there is a device that'll have you pummeling your enemies with a Hadouken in no time. The Quadstick uses a standard directional joystick, which is pretty obvious, but it's the way it uses "sips and puffs" on the stick to allow the user to input button presses. The manufacturer warns it takes quite a bit practice, but when you really need to get the beat down on your opponent, it's a small price to pay. There's also an FPS version.

PointCTRL

I've had one of these on backorder for 18 months now, as the single 3D printing hobbyist who makes these is utterly overloaded with orders from flight sim fans. We've read enough about it to know we want one though – these little resin-printed boxes of magic clip onto your index finger, and are then tracked by a tiny camera that goes on your HMD. Strap into your virtual F-18 cockpit, and you can literally reach out and touch the cockpit buttons with your actual hands. There isn't any tactile push back when you hit the button, as the creator hasn't figured out how to bend atoms, but apparently the result is still incredibly immersive. ■





FEATURE - PART 5

(R)evolution of Portable Audio: Back in a flash

The path to portable digital music would be potholed with failed products and legal threats, but as Darren Yates writes, it was the personal computer that finally brought music into the 21st century.

Above: The iPod Mini in 2004 was Apple's first no-moving-parts music player (Image credit: Apple).

Below: The legendary Sony TCD-D7 portable digital audio tape recorder (Image credit: Binarysequence, CC BY-SA 4.0).

As we've seen throughout this series, any portable audio revolution is usually preceded by years, or even decades, of research and development before an idea reaches a level of maturity for it to take off. However, an idea of Toshiba electrical engineer Fujio Masuoka was so far-reaching, it was to have ramifications well beyond the field of portable audio. As tech giants Sony and Philips were prepping the Compact Disc, Masuoka's invention of fast-erase floating-gate memory would set in motion development of the world's first practical no-moving-

parts data storage device. The global tech industry, and portable audio in particular, were about to move into the fast lane.

No moving parts

Masuoka had already been quite prolific during his early days at Japanese tech giant Toshiba. He'd developed the 1Mbit Dynamic Random Access Memory (DRAM) chip in 1977, but his passion was for a memory chip that didn't need power to retain data. Electrically-Erasable Programmable Read-Only Memory (EEPROM) was the hot storage technology of the 1970s and unlike standard DRAM that powers our PCs today, EEPROM could retain data when power was removed. What made EEPROM so important for its time was that it only required an electrical voltage to erase data – previous EPROM chips required ultraviolet light to do the job. Even so, the erase process in EEPROM was still quite slow, but EEPROM nevertheless found use in early computer systems and still appears in many household devices and appliances (including washing machines).

Masuoka's 1980 invention enabled the erase process to occur

almost instantly, by grouping memory cells together in 'pages', to which a voltage could be applied, erasing the cells in bulk. The name 'flash' was suggested by this new erase speed. Sadly for Masuoka, however, Toshiba failed to grab its opportunity to lead the flash-memory market and in 1994, Masuoka quit Toshiba and returned to Tohoku University. Since then, Toshiba's Westinghouse nuclear plant division filed for bankruptcy in 2017, forcing Toshiba to sell a majority stake in its memory chip business, Toshiba Memory, to private-equity firm Bain Capital the following year. In 2019, the joint-venture rebranded as 'Kioxia'.

Digital Tsunami

The 1982 launch of the Compact Disc changed consumer expectations for audio quality. Years of dealing with background hiss and noise-reduction were gone thanks to this new tech delivering seemingly-perfect sound literally on a 'silver platter'. But Compact Disc didn't solve the next question – how to record digital audio. Sony's PCM-1 Processor and Betamax video cassette recorder (VCR)



combination may have been first, but with Sony conceding defeat in 1988 and releasing its first VHS recorder, neither Betamax nor VHS were the ideal option. However, the launch of Compact Disc opened the flood gates, as new media formats attempted to win over the home-recording market.

Digital Audio Tape

One of the first was Digital Audio Tape or DAT. Released in 1987, DAT was a cassette format larger than a MiniDV video-camera tape but smaller than the original Compact Cassette. Essentially, a DAT recorder was a mini VCR, pulling the 3.81mm-wide magnetic tape around a cylindrical drum recording head. Similar to VCRs, the head used a 'helical scan' technique in which multiple heads spun around at 1500RPM while the tape itself was pulled horizontally around the drum at just 8.15mm/second. DAT allowed for the recording of lossless PCM (pulse-coded modulation) stereo (two-channel) audio at up to 48kHz sample-rate and 16-bit depth (32/44.1kHz was also supported).

DAT resulted in some of the most compact recorders seen to-date, including Sony's TCD-Dx series. Other manufacturers also jumped on-board, including TASCAM, with its excellent DA-P1.

However, the Recording Industry Association of America (RIAA) was less enthusiastic. For the first time, the home user could make copies of CDs as good as the original - this led to an RIAA executive threatening to sue any company attempting to launch a consumer-grade DAT recorder in the U.S.

Sony's purchase of the giant CBS Records in 1988 reportedly calmed tensions, but in the end, DAT failed to achieve the success it did in Japan and faded from the market during the 2000s. Nevertheless, before the arrival of the optical CD-recordable format in the mid-1990s, DAT was the only lossless digital audio recording format available to consumers.

Digital Compact Cassette

Meanwhile, Philips couldn't just let go of its Compact Cassette and explored options to create a digital version. DAT's helical scan or 'rotary' head assembly was

expensive and costly to produce, so Philips combined with Matsushita to create a new type of stationary or 'fixed-position' head, similar to that used in the original compact cassette. What's more, Philips' aim was for this 'Digital Compact Cassette' (DCC) to use the original's 4.75cm/second tape speed and 3.8mm tape-width, but also make its DCC cassette decks backward-compatible and play original Compact Cassettes.

However, there was a problem - using a fixed head reduced the bandwidth to a point that standard pulse-coded modulation (PCM) was just not an option (which is why DAT used helical-scan heads).

The solution was launched in late-1992 and was equally as radical - Philips developed what was called 'Precision Adaptive Sub-band Coding' to reduce the audio bit rate from over 1.5megabits per second (1.5Mbps) to just 384kilobits per second (0.384Mbps). The compression format would eventually be rolled into the first MPEG audio standard (which was known as MPEG 1 Layer 1).

The DCC format also included commercial copy-protection to prevent home users making digitally-perfect copies of commercially-bought music DCCs. However, DCC didn't take with the market and by 1997, Philips had discontinued the tech and the 'compact cassette' era was effectively over.

MiniDisc

As Philips and Matsushita were readying DCC for market, Sony was putting the final touches on its consumer DAT-replacement. Instead of a cassette mechanism, Sony went for an enclosed 'floptical' disc-style format it called 'MiniDisc'. Rather than being purely magnetic, the disc media was a combination magneto-optical and used a

magneto-optical head. Like CD, MiniDisc used a laser diode to read data, but the difference here was that during writing, the laser was employed to heat the recording

location while the magnetic portion of the head 'wrote' the data to the disc. Recordable discs would eventually be available in 60-, 74- and 80-minutes duration.

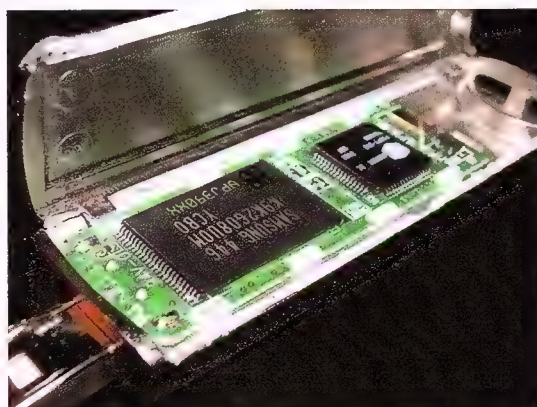
Like DCC, MiniDisc not only came with protection to prevent digitally-perfect copying, but also used audio compression. The compression format was a Sony-invention dubbed 'Adaptive

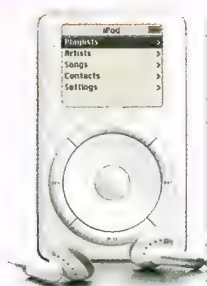
Above: DCC decks were backwards-compatible and could play your old analog cassettes (Image credit: JProche, CC-BY-SA 3.0).



Above: Philip's Digital Compact Cassette used audio compression to store digital audio on tape (Image credit: Paul Forsdick, CC-BY 2.0).

Below: Flash memory has made possible all of our portable devices (Image credit: Nrbelex, CC BY-SA .30).





Above: Still mechanical, but the original iPod changed the way many listened to music (Image credit: Apple).

Right: The Sony-designed MiniDisc used ATRAC audio compression to fit 80mins to a disc (Image credit: Ramon Vasconcellos, CC BY 3.0).



Transform Acoustic Coding' or 'ATRAC'. While it dropped the 1.5Mbps PCM data stream down to approximately 300Kbps, Sony did enable later MiniDisc systems to record in standard PCM format.

However, by the time it did, MiniDisc was fairing only marginally better than DCC. Sony doubled, then quadrupled the disc recording time through higher-compression ATRAC extensions 'LP2' and 'LP4', but LP4 was more suited to voice-recording than music. Nevertheless, MiniDisc only finally left the market when Japanese brand TEAC dropped its consumer and professional offerings in 2020.

CD-ripping

Until the arrival of flash-based music players in the late-1990s, music was typically a lossy

business – consumers had to copy LPs or CDs onto other media, whether cassette or MiniDisc, using analog-transfer techniques that resulted in an overall loss of audio quality. Flash-based music players (and later MiniDisc models) changed this and brought a new entertainment device to the process – the desktop computer. New terms such as 'CD ripping' and 'audio compression' entered the broader lexicon, as consumers began the search for software to 'rip' their music CDs into compressed audio formats such as MP3.

By now, Compact Disc technology was heading towards 20 years old – it arrived just weeks after the Commodore 64 home computer, so it's hardly surprising that little thought was given to the possibility that one day consumers could use their computers to make digitally-

perfect copies. But the mid-1990s 'Internet Revolution' had seen multimedia PCs with CD-ROM drives increasingly finding their way into homes. It's likely only that the earliest flash-based music players measured their storage in megabytes and not gigabytes that forced consumers to use lossy compressed audio formats such as MP3 and ATRAC, rather than use lossless PCM-format copying.

Peer to peer

In fact, the fear that led some music industry executives on a collision course with DAT was that consumers would begin making digitally-perfect copies of CDs and start sharing those tapes around, cutting the bottom out of the then-lucrative music business. While the DAT threat didn't eventuate, all the ingredients were ready by the late-1990s for a situation that potentially would be far worse.

In June 1999, those ingredients came together in the music-sharing website called 'Napster'. Combining almost-instant access to thousands of songs through a free and slick web interface saw Napster's star rise. However, it was more a 'shooting star', as the music industry rallied to the threat and filed lawsuits against the service. Just over two years later, Napster was shut down by the U.S. court system in July 2001. But with Napster, at one point, said to have had 80 million users, the growing realisation within the tech industry was that a new market opportunity beckoned.

Right place, right time

The story of how Apple nearly lost its way and survived thanks to US\$150million from Microsoft boss Bill Gates in 1997 is well known, yet in the space of just two years, the company went from rags to riches on the back of its booming iMac design. But Apple wasn't done yet and in January 2001, launched the app that would go on to change how millions around the world consumed their music – iTunes. The launch was also clever for iTunes being for Mac only. The iTunes app was reportedly a redesign and development of SoundJam MP, which Apple had bought the previous year. Quickly, Mac users became iTunes' greatest advocates as they began cataloguing and grouping their music library. However, iTunes itself was only

Below: The Sony MZ-RH1 was arguably the pinnacle of MiniDisc portability (Image credit: Zlois, CC BY-SA 3.0).





one half of a double-act that would change the music industry forever – and consumers didn't have long to wait.

One more thing

When Apple then-boss Steve Jobs announced in October 2001 the company's plans to become market leader in the digital music revolution, he didn't actually say 'one more thing' – but he did announce the product every other company then dreamt of having: the Apple iPod.

Apple certainly wasn't first to market with a portable audio player, but it had the right ideas at the right time. Only a matter of weeks prior, the music industry had successfully overcome the Napster threat, but any thought that it could stave off the future and expect consumers to go back to buying CDs forever was wishful thinking. The Napster furore would only be the beginning if the music industry didn't move with the changing demands of consumers.

Even without the Windows PC market, the iPod/iTunes combination was a winner. However, the first iPod was still an electro-mechanical device and not particularly sophisticated when you look back, relying on a 1.8-inch Toshiba hard drive of either 5 or 10GB capacity and powered by two ageing 90MHz ARM7-grade microcontroller chips. However, its revolutionary 'click wheel' control made navigating through song lists intuitive and easy. Apple was bringing a new design language to technology and consumers couldn't get enough.

Regardless of whether or not you're an Apple fan, the iPod completely transformed the portable audio market, changing how and where we consumed music. So entrenched in our psyche did the iPod become that it was only in 2022 that Apple finally announced the end of the iPod, with a 'last call' for the

last-surviving model, the iPod Touch, it's iPhone-without-the-phone player/app combo.

Buying music online

But by 2003, iPod storage capacity had risen from 5GB to 40GB, enough for over 10,000 songs and it was clear that ripping that many CDs was no longer an option. The same day the 40GB model was announced, Apple also launched the new iTunes store

and for the first time, consumers could legally purchase and download music online. A new Windows-version iTunes store client soon followed.

The staggering number of Napster users showed the vast potential of a music marketplace and it was during 2002 that Steve Jobs began the painstaking task of bringing the record labels on-board. Eventually, market heavyweights Warner Music and Universal agreed, provided safeguards to prevent wholesale copying (what became 'digital rights management') were incorporated. Further deals with BMG, EMI and Sony were

eventually sorted and a reported 200,000 songs were ready to go the day the iTunes Store launched in April 2003. But how did consumers respond? The store was an instant hit – more than one-million songs were purchased in the first week alone.

Market collapse

Nevertheless, what was so remarkable about the rise of the portable music player was just

how fast the global market for these devices began unravelling less than a decade later. Music sales continued to boom, but as per usual, a new device was

"Combining almost-instant access to thousands of songs through a free and slick web interface saw Napster's star rise."

coming – this time, one that would rewrite the definition of 'personal computer' and all but make the MP3 music player redundant.

Next time, in the final part of this series, we hit modern times, as Apple and new player, Google, sign the death warrant of the music player market with the launch of this new device that still shows few signs of slowing down. ■

Above: Music players rarely got smaller than the Apple iPod Shuffle (Image credit: Apple).



Above: The Diamond Rio PMP300 was one of the first flash-based audio players to hit Australia (Image credit: Public Domain).

Below: The Sony PCM-1630 PCM adapter turned any VHS recorder into a digital audio recorder (Image credit: Akakage1962, CC-BY-SA 3.0).





ANTIVIRUS

GO FREE OR BUY A SUITE?

We put a dozen free AV products and fully fledged security suites through their paces to find which are worth your time and financial investment.

Antivirus software continues to be a contentious topic. Some vehemently argue that the protection built into Windows, macOS, iOS and Android is more than enough to keep people safe. Others prefer to invest in a suite that will cover not only their main PCs but also their mobile devices, not to mention those of their family.

Then there's business protection. While that's beyond the scope of this group test, which is focused on consumers, we reveal what's on offer for companies of all sizes – including Microsoft's heavily integrated solution, for better or worse.

So, how do you decide what's best for you? By being informed. We use data from three independent testing houses as the basis of this Labs, and with a summary of results on p76. The good news is that all the main products offer excellent protection, but some – how do we put this delicately? – are more intrusive than others.

We also suggest you examine our feature table on p62 closely. This details exactly what features are included with each product, and our buyer's guide on p64 will help you work out what you might actually want or need for your protection.

But the most important aid of all is our reviews. Based on the results and our own usability testing of each package, these will give you a concise verdict on the 12 products on test.

Contributor: KG Orphanides

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	RECOMMENDED					LABS WINNER
	Avast One Essential	Avira Free Security	Bitdefender Premium Security	Eset Internet Security	F-Secure Safe	G Data Total Security
SCORE	★★★★★	★★★★★	★★★★★	★★★★★	★★★★☆	★★★★★
Website	avast.com	avira.com	bitdefender.com.au	eset.com/au	f-secure.com	gdatasoftware.com
Desktop clients	macOS, Windows	macOS, Windows	macOS, Windows	macOS, Windows	macOS, Windows	macOS, Windows
Mobile clients	Android, iOS	Android, iOS	Android, iOS	Android	Android, iOS	Android, iOS
PRICING						
First year's price (1yr)	Free	Free	\$199.99, 10 devices	\$59.95, 1 device; \$69.95, 2 devices; \$79.95, 5 devices; \$149.95, 10 devices	US\$49.99, 1 device; US\$55.99, 3 devices US\$59.99, 5 devices	US\$49.95, 1 device; US\$55, 3 devices; US\$68, 5 devices
FEATURES						
Firewall	✓	✗	✓	✓	✗	✓
Browser protection: link checking or site blocking	✓	✓	✓	✓	✓	✓
Ransomware protection (dedicated module)	✓	✗	✓	✗	✓	✓
Cloud backup	✗	✗	✗	✗	✗	✗ (local backup included)
Webcam protection	✗	✗	✓	✓	✗	✗
VPN	✓ (5GB per week)	✓ (500MB per month)	✓	✗	✗ (Total only)	✗
Password manager	✗	✓	✗	✗ (Premium only)	✗ (Total only)	✓
Scheduled scans?	✓	✓	✓	✓	✓	✓
Silent detection mode	✓	✗	✓	✓	✓	✓
Parental controls	✗	✗	✓	✓	✓	✓
Device management/tracking	✓ (mobile only)	✗	✓	✓	✓	✗
Bootable rescue disk	✗	✓ (free download)	✗	✓ (free download)	✗	✓
Breach monitoring	✓	✓	✗	✗	✓ (free on-demand tool)	✗
Data broker removal service	✗	✗	✗	✗	✗	✗
Identity theft/lost wallet support	✗	✗	✗	✗	✗	✗
TEST RESULTS						
AV Comparatives Real-World Protection – % blocked	100%	99.8%	99.7%	98.9%	N/A	100%
AV Comparatives Real-World Protection – false positives	2.5	2	2	1	N/A	9
AV-Test Real-world (batch 1)	100%	100%	100%	N/A	100%	100%
AV-Test Real-world (batch 2)	100%	100%	100%	N/A	99.2%	100%
AV-Test Reference (batch 1)	100%	100%	100%	N/A	100%	100%
AV-Test Reference (batch 2)	100%	100%	100%	N/A	100%	100%
AV-Test false positives (total)	0	0	5	N/A	0	1
AV-Test protection score (out of 6)	6	6	6	N/A	6	6
AV-Test performance score (out of 6)	6	6	6	N/A	5.5	6
AV-Test usability score (out of 6)	6	6	5.5	N/A	6	6
SE Labs Protection rating	100%	99%	99%	N/A	N/A	N/A
SE Labs Legitimate Accuracy	96%	100%	100%	N/A	N/A	N/A
SE Labs Total Accuracy rating	97%	99%	100%	N/A	N/A	N/A



	RECOMMENDED	RECOMMENDED			
Kaspersky Internet Security	McAfee+ Advanced	Microsoft Defender Antivirus	Norton 360 Advanced	Panda Free Antivirus	Trend Micro Maximum Security
★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
kaspersky.com.au	mcafee.com/en-au	microsoft.com	au.norton.com	pandasecurity.com	trendmicro.com/en_au
macOS, Windows	Chrome OS, macOS, Windows	macOS, Windows	macOS, Windows	Windows	Chrome OS, macOS, Windows
Android, iOS	Android, iOS	✗	Android	Android	Android, iOS
\$34.95, 1 device; \$36.95, 3 devices; \$37.95, 5 devices; \$41.95, 10 devices	\$139.95, individual, unlimited devices	Free with Windows 10 and 11	\$104.99, Standard, 1 device with VPN; \$89.99, Deluxe, 5 devices, with parental controls; \$149.99, Advanced, 10 devices, with identity restoration	Free	\$69.95, 1 device
✓	✓	✓	✓	✗	✓ ("booster")
✓	✓	✓	✓	✗	✓
✓	✓	✓	✓	✗	✓
✗	✗	✓ (5GB via OneDrive)	✓ (10GB to 200GB)	✗	✗
✓	✓	✗	✓	✗	✗
✓ (300MB per day)	✓	✗	✓	✓ (150MB per day)	✗ (Premium only)
✓	✓	✓ (via Microsoft Authenticator)	✓	✗	✓
✓	✓	✓	✓	✓	✓
✓	✓	✓	✓	✗	✓
✓ (Family plan only)	✓ (Family plan only)	✓	✓ (Deluxe and above)	✓ (Android only)	✓ (Android and iOS only)
✓	✓	✓	✓	✓	✓
✓ (free download)	✗	✗	✓ (free download)	✓	✓ (free download)
✓	✓	✗	✓	✗	✗
✗	✓	✗	✗	✗	✗
✗	✓	✗	✓	✗	✗
99.7%	99.8%	99.5%	99.9%	99.7%	99.8%
1	4	7	29.5	36	42
100%	100%	100%	100%	N/A	100%
100%	100%	100%	100%	N/A	98.4%
100%	100%	100%	100%	N/A	100%
100%	100%	100%	100%	N/A	100%
0	0	0	0	N/A	1
6	6	6	6	N/A	5.5
6	6	5	6	N/A	6
6	6	6	6	N/A	6
100%	100%	100%	100%	99%	N/A
100%	99%	100%	98%	100%	N/A
100%	99%	100%	99%	99%	N/A

We need to talk about AV software: a buyer's guide

If you're running Windows 10 or 11 then it has built-in AV protection, so why worry about buying software? It's a fair question, but not the only one you need to answer.

Modern security software packs in loads of features, but if you're shopping for antivirus software then your top priority is simple: not getting infected by malicious software.

That means that real-time malware protection is the critical feature of a security suite. This is a service that continuously monitors your PC for malicious software, primarily by scanning new files and websites your computer encounters.

It's also our minimum bar for inclusion in this group test. For example, the free edition of Malwarebytes is effective and justifiably popular but, unlike its paid-for version, it only provides on-demand scanning.

Every single product in this group test is capable of protecting your computer against the vast majority of malicious software. Performance analysis of malware protection is in the business of assessing edge cases, unfamiliar malware and false positives. These marginal instances can have an impact on your quality of life and, potentially, the health of your PC.

Malware signatures – the hashes of known malicious files – remain important to both real-time and on-demand scanning, and this is why you still see testing houses running flat file scans against large batches of recently collected malware introduced on a disk.

But polymorphic viruses and other forms of obfuscated malware have been around for decades, which is where heuristic scanning comes in: this looks at



Above: Preventing infection should be your top priority. productivity tasks.

characteristics and behaviours of a suspicious file or process to determine whether it's likely to be a threat.

Does it use known detection-evasion techniques such as encryption or compression ("packing")? Does it engage in potentially threatening behaviour such as attempting to delete files or terminate processes? Characteristics like these allow antivirus software to decide whether an unknown program is likely to be a threat or not.

Can it beat Microsoft Defender?

The fundamental question about any third-party antivirus solution is whether it can consistently perform better than Microsoft Defender antivirus, which comes built into Windows 10 and 11, and requires no additional software installation or payment.

We'll be reviewing the free "for individuals" version of Microsoft Defender that ships with the operating system on the same terms as its rivals, but the fact that you don't need to install anything new or update any licences makes it a compelling choice when it

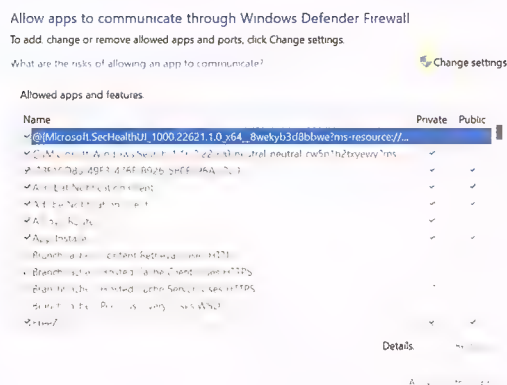
comes to protecting the PCs of less tech-savvy friends and relations. But that's only assuming that its protection continues to meet the grade.

At the start of its life, Defender didn't. However, due to the huge number of systems on it's deployed, Microsoft has a real advantage when it comes to obtaining malware samples to analyse, which informs not only its malware signature database, but also the behaviour data it has to add to its heuristic rules of thumb for sketchy software.

Over the past few years Defender has matured into a piece of software that even seasoned security experts have started to respect, and that's been based on a fine string of performances across the likes of AV Comparatives, AV-Test and SE Labs.

How much to pay

Just for once, free antivirus isn't one of those you-get-what-you-pay-for deals. In fact, there are good reasons for companies to produce effective free AV software: they benefit by getting more data about malware that their free users encounter.



by promoting their paid-for products, and by the reputational boost that their free products bring.

Naturally, though, they want to upsell you to their full security suites. These generally include features that are more expensive to provide, from online password managers to cloud backup and even hands-on helplines in case you lose your wallet or have your identity stolen.

We've roughly divided antivirus suites into free products, mid-tier services that you can expect to pay around \$100 a year for, and high-end suites with numerous service-based features, plenty of installation licences and a price that works out at \$140 or more per year.

All those are renewal prices. Rare exceptions such as G Data aside, the AV companies employ the same tactic as many broadband suppliers: cut-price deals for the first year to lure you in, then more expensive renewals. Although the warnings and advertising around this have become clearer, we aren't fans of this approach – not least because if you buy direct from the companies then they have your card/account details and will auto-renew.

Extra features

Our reviews are weighted heavily towards protection against malware, in real-time. However, most of the products in this group test do a lot more, helping to justify their status as card-carrying security suites.

Some of these features are tied to device security: ransomware protection that can lock down and/or back up your most important folders; web-based management consoles that allow you to remotely find, lock down or wipe lost computers or mobile devices; bootable rescue disks to help you recover after a malware infection.

Then there's dedicated webcam protection and firewall software that, in almost all cases, has a less creaky interface for creating rules than Microsoft's integrated solution.

Others are still security-oriented, but a little broader in the net they cast – they're usually things that you might otherwise buy as a dedicated service, such as password managers, parental control software, cloud backup



Above: The parental controls in AV suites are often no better than those in your OS.



services and VPNs.

While it's convenient to get everything bundled together, you're rarely going to get the best of all worlds. Plus, we don't think it makes sense to invest in a password manager with one provider when you may switch in a year's time; far better to invest in the likes of 1Password or use Bitwarden for free. The same is true for cloud backup, as shifting this from one provider to another is a hassle.

The bundled VPNs are fine for occasional use, but power users will want more. For example, if you use multiple operating systems, or want a VPN that you can deploy to your router, the VPNs bundled with security suites rarely provide sufficient flexibility.

Bundled parental control suites tend to be mostly okay, with the

caveat that they don't do much that Microsoft Family Safety or macOS Parental Controls don't, unless you're in the market for a cross-platform solution.

The final category of extras consists of tools such as local encrypted data stores, secure file shredders, registry cleaners, disk usage analysers and even disk defragmenters. Although they can be handy, there are free/open-source applications that do as well or better in almost all cases, so these can be safely ignored as filler.

The bottom line is this: if you're mainly looking for malware protection, but with some extra options in case you need them, then most services we've reviewed do an adequate job. You don't need to pay more to get better protection against malicious software.



Right: Some products offer dedicated webcam protection.

AVAST ONE ESSENTIAL

The best third-party free antivirus for Windows is also one of the most effective at crushing malware.

★★★★★

Free | from avast.com



Avast is one of the best-known names in free antivirus, and its paid-for products don't slouch, either. Its malware detection engine is the only one in this group test to score a 100 percent protection rating from AV-Test, AV Comparatives and SE Labs for successfully blocking all malicious files. It didn't do such a perfect job when it came to correctly allowing through legitimate software and websites: AV Comparatives found that it blocked two benign items and asked the user to decide about a third, while SE Labs gave it a total accuracy score of 97 percent.

Avast One Essential is essentially the same as the older Avast Antivirus Free, but with a shiny new interface and an integrated VPN on the front page. Although the layout is more spacious than its predecessor, it's harder to navigate, with concealed buttons to close alerts and tiles that are buttons themselves – and have secondary buttons within them. It's not the clearest design language Avast could have chosen, but it only took a few minutes to get used to.

The Home page features several configuration and activation shortcuts, including the free version of Avast's VPN, limited to 5GB of traffic a month from your nearest VPN endpoint and a scan centre where you can run and schedule various on-demand scans.

Less useful tools include PC Speedup, which improves performance by preventing applications from auto-starting at boot or preventing them from working in the background. This isn't always actually desirable. We were recommended one that prevents OneDrive from syncing files until it's open. To be fair, Avast does warn users to ensure that they don't optimise syncing programs to the point of non-functionality.

There's also a browser cleaner, which clears your browsers' caches and cookies, as well as a disk cleaner

and driver updater, which are only available to premium users.

The full list of tools can be accessed in the Explore tab. There's File Shield, an on-access file scanner, Web Shield browser protection, Ransomware Protection (which prevents unauthorised changes to your most important folders), a Quarantine area for detected malicious files, and a network inspector that you can use to scan for potential vulnerabilities on the LAN you're connected to.

Email Guardian scans inbound POP3 and IMAP email and outbound SMTP for threats, while Password Protection is a data breach alert service you can subscribe to if you create a free Avast account. While free data breach notification services are fairly common, this is a useful addition for those who wish to create an account.

Privacy Advisor sounds quite interesting, in that it promises to help you keep the likes of Google and Facebook from tracking you, but the reality is less impressive: it's just a checklist of settings to disable and omits some obvious privacy risks, such as Windows' own default settings. However, it's useful if you don't already know how to check your account privacy, and these guides could be handy for less technical users who nonetheless value their privacy.

Features that are only available to paying subscribers appear alongside other tools, where they're marked with a lock symbol. You'll be prompted to upgrade if you click on them. Paywalled features include webcam protection, a "Sensitive Data

Avast One Essential has an integrated VPN on the front page.

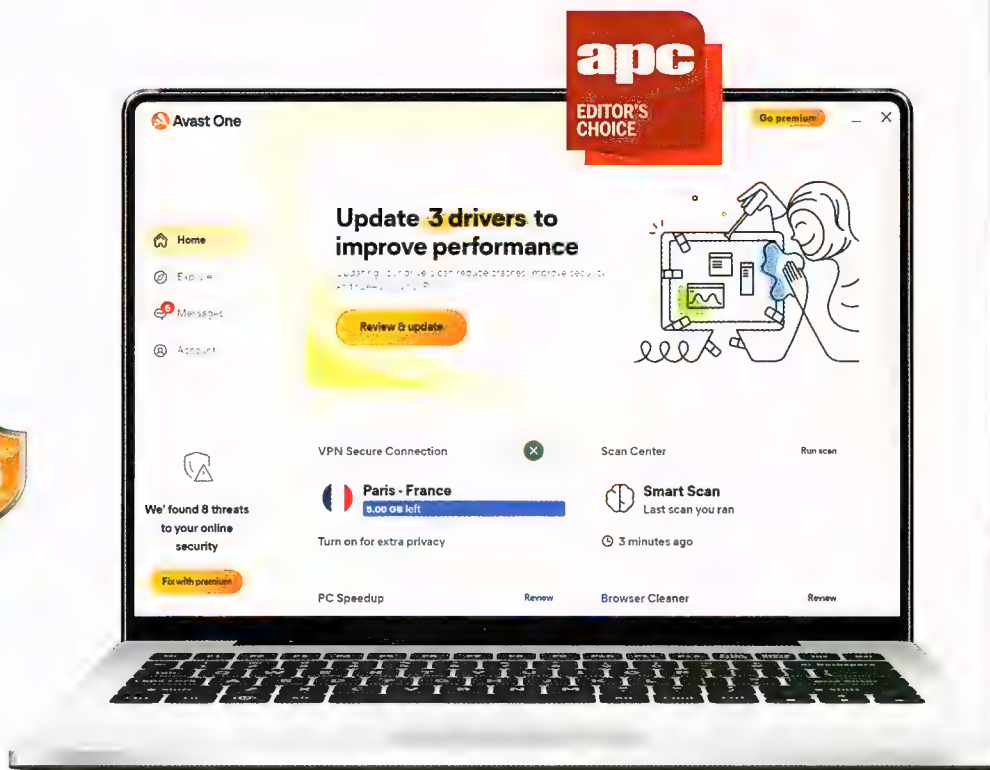
Shield" to change the permissions of specific files and folders so that only you and specifically authorised users can access them, webmail protection, private browsing and web tracking avoidance, and a couple more update tools.

Free users now appear to get a few features that used to be only for paying subscribers, notably a firewall, but this is just a nicer overview interface for Windows' integrated firewall, and doesn't allow you to open or close ports by number. Some extra "Advanced network security" options are for Premium users only.

Because this is the free edition, you'll see some paid promotions and ads for Avast's paid-for security products. These start with an install-time invitation to add Google Chrome to your PC alongside Avast. Once you've got everything installed, you'll encounter a few more promotional messages, including a "Go Premium" button and the occasional pop-up. Promotions for Chrome may also appear in Avast's software updater if you don't have it installed.

You also get extra promotions in some scan results. Full scans include a "PC cleaning" section that suggests you upgrade to Premium if you want Avast to help you empty your recycle bin, delete broken registry keys and delete temporary files.

Avast, like sibling product AVG, which uses the same detection engine, continues to be a reliable choice for any user who wishes to switch away from Microsoft Defender, without paying for a bells-and-whistles laden security suite.



G DATA TOTAL SECURITY

Excellent malware defence and clear pricing make up for some creaky system optimisation tools.

★★★★★

(5 devices) US\$68 | gdatasoftware.com



G Data is a long-established independent anti-malware firm based in Germany. It combines its own internally developed malware-detection engine with the Bitdefender engine, which helps it identify threats with formidable accuracy.

In fact, its malware detection has been among the most effective recently, blocking 100 percent of malware in tests by both AV-Test and AV Comparatives. It misidentified a few legitimate programs as threats, however – one in AV-Test's set and nine in AV Comparatives'.

Total Security is the most comprehensively feature-packed version of the company's antivirus suites, available for Windows and macOS, with complementary iOS and Android apps.

G Data is sold in US dollars, which currently works out as follows: US\$50 is around \$75 for a one-device subscription, US\$66 is roughly \$98 for three devices and US\$82 equates to \$121 for five devices.

Very unusually for antivirus software, there are no hidden renewal costs, making this a mid-priced, mid-range security suite that stays that way. This is genuinely refreshing in an industry that's had numerous auto-renewal price-hike scandals.

As well as the core antivirus suite, it comes with the same firewall and parental controls as G Data Internet Security, plus a password manager, parental controls, performance tuner, encryption tools and USB device access control. Installation deposits a pair of shortcuts on your desktop: the G Data Total Security client and G Data Shredder, which will securely delete files or folders that you drag onto it.

The G Data client itself is an almost charmingly old-school security suite control panel, with bright colours, lots of information and a clear set of icons. The main

pane gives you a heads-up display of the status of the suite's core modules.

Under Virus Protection, you can run or schedule a full malware scan, or scan specific files or directories, your computer's memory and autostart processes, removable media, and check for rootkits. You can also access quarantined files or burn a bootable rescue image to a CD or USB drive.

G Data Total Security comes with a dedicated firewall to replace the Windows Defender Firewall. There's not a lot in it, but we found the interface to create new firewall rules more pleasant to work with than Windows' integrated one. The firewall is on autopilot by default, ensuring that you'll spend as little time interacting with its rules as possible.

The suite also comes with a comprehensive integrated backup tool. It supports full, differential and incremental backups of any selected files and folders, on a schedule of your choice. You can back up to physical media, a network location or synced storage such as OneDrive.

Unfortunately, it's all downhill from here for the bundled apps. The integrated password manager is minimally documented, only works via a browser and provides plugins only for Google Chrome and the long-outdated Internet Explorer. We recommend using a dedicated password manager such as KeePass or Bitwarden instead.

The near-obligatory system tuner, designed to tweak Windows settings, is full of features from the past. There's a disk defragmenter

The bright screen produces rich colours and sharp images.

that doesn't warn you not to defrag SSDs, while the clean-up tools refer to long-dead products such as Google Picasa and the Yahoo Browser Toolbar.

Parental Controls are simple and clear, allowing you to tie controls to a specific user. You can restrict their access to the internet and applications by time and category, but they do nothing that Windows Family Safety can't. It also feels as if it hasn't been updated in a while: for example, if you tick "block all encrypted websites", that includes anything with a TLS certificate and https prefix. Otherwise known as most of the modern internet.

Let's end on positive notes. An encryption tool creates and mounts an encrypted virtual partition (although this is too easy to delete), you can improve boot times by delaying autostart applications, while device control can block unauthorised USB devices, discs, webcams or floppy disk drives from being used.

While some of the more outdated "value-add" features could be unruly in the hands of someone who doesn't know their way around their PC, this is a security suite that power users should be able to get behind. And for those who prefer not to be bothered by their antivirus, you can instruct G Data not to display malware detection messages.

G Data Total Security is an excellent security suite that easily dominates its mid-range price bracket.



McAfee+ ADVANCED

Expensive, but this powerful suite supplements malware protection with unusual identity protection features.

★★★★★

(Unlimited devices, individual) \$139.95
mcafee.com/en-au



Cut loose from Symantec and now fully focused on consumer security, McAfee has added a couple of new products to the top end of its range: McAfee+ Premium and Advanced, which currently slot in above McAfee Antivirus Plus and Total Protection.

They're at the top end of the price bracket, too, with Premium coming in at \$139.95 per year for an individual subscription. First-year discounts are available for new subscribers.

Unlike other McAfee subscriptions, Premium and Advanced support an unlimited number of devices, which could be a real boon for the household that has some kind of computer or mobile device in every room. Family subscriptions add parental control software but are otherwise the same as their individual counterparts.

Both of the new tiers include a full subscription to McAfee Secure VPN, which has been upgraded to use TunnelBear's infrastructure and finally has a kill-switch, bringing its feature and performance in line with the rest of the market. There's also a password manager, identity monitoring to see if your data appears in any known breaches, and a Personal Data Cleanup service.

For Premium users, that clean-up service will alert you to information held about you for sale by online data brokers, making it easier to contact them and request its removal. Advanced subscribers get a full-service removal package, in which McAfee will contact data brokers for you and keep you off their data lists. This is an extremely unusual feature that's more often found as a specialist identity protection service for people at risk of doxxing or

identity theft, and it could be greatly reassuring.

Advanced subscribers also get extra identity protection and recovery features, including support lines you can contact in case of a lost wallet or suspected identity theft. Here, someone will guide you through the process of contacting banks and other institutions to remedy the situation.

This kind of identity protection service is still relatively unusual. Norton LifeLock provides a similar service with Norton 360 Advanced at a similar price, making the two services direct rivals. If you have to choose between the two, though, Norton doesn't currently offer data broker removal and produced a rash of false positives in recent tests by AV Comparatives, making McAfee the better choice.

McAfee's performance in recent group tests has been excellent. It detected all malware with no false positives in AV-Test's latest roundup of Windows consumer antivirus tools. In AV Comparatives' tests, it picked up 99.7 percent of malware and a single false positive, and it blocked 100 percent of malware in SE Labs' tests, but dropped to 99 percent in its total accuracy rating for blocking legitimate software.

It's really good at protecting you against malware, but even in its latest incarnation, McAfee has a reputation to overcome. It's a market leader, but a lot of this dominance originated by dint of

McAfee+ performed admirably in all the malware detection tests.

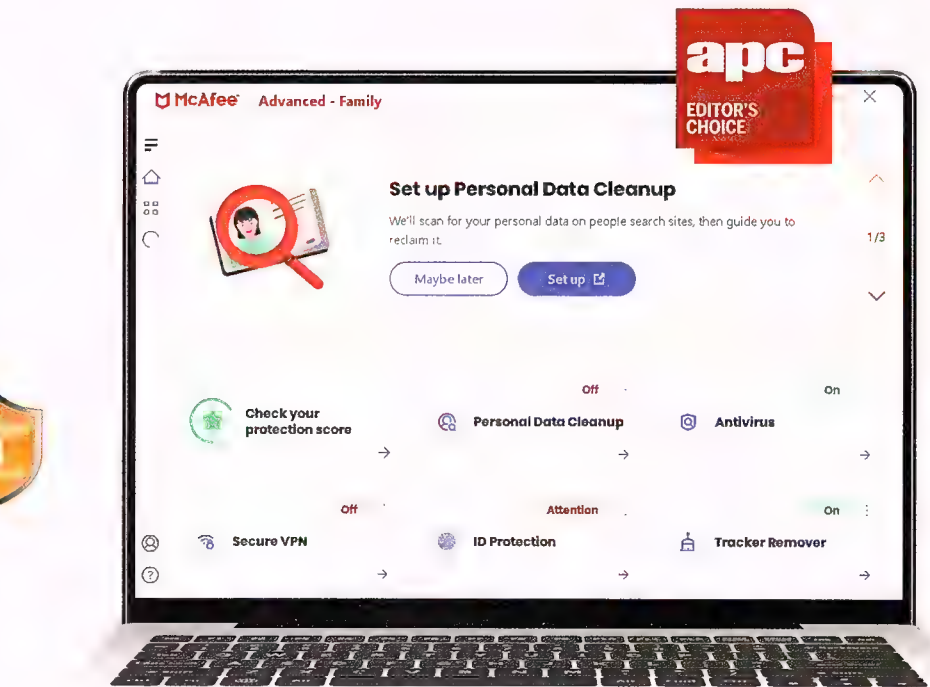
trial versions coming pre-installed as part of deals with PC makers. This in turn led to a lot of complaints from users who just wanted to get rid of it.

Then there's the industry-wide problem of subscription rates that go up after the first year. In general, most companies offering these security and anti-virus services have been compelled to make it easier to switch off auto-renewals, to provide clearer information about pricing, and to offer refunds to users who made a claim, usually within 60 days of the payment being made.

All the usual features you'd expect of an antivirus suite are present and correct, including real-time and scheduled scans, an easy-to-use firewall, software updater, cookie and tracker remover and an online security portal.

If you're willing to spend a large chunk of money on security software with some high-end identity protection features, or if you want to at least take advantage of the first-year offers and carefully cancel afterwards (in-store licences for physical purchase aren't available yet), then McAfee+ Advanced is definitely the way to go.

If you just need to protect some PCs from malware, on the other hand, then Avast, G Data and indeed Microsoft Defender all fulfil that task similarly and cost a great deal less.



MICROSOFT DEFENDER ANTIVIRUS

Microsoft's hassle-free integrated malware defences epitomise "if it ain't broke, don't fix it".

★★★★★

Free with Windows 10 and 11



Microsoft markets a whole range of personal and enterprise security products under the Defender brand. In this review, we're specifically looking at the free Microsoft Defender Antivirus and associated features that come built into the Windows 10 and Windows 11 Security app.

This includes a raft of anti-malware defences, including the all-important real-time protection. There's also the Windows firewall, which is perfectly functional, even if the interface for opening ports isn't as glossy as some rivals. And the final big weapon is Microsoft Family Safety, one of the best parental control suites around.

You may be surprised to hear that it has dedicated ransomware protection tools, too. Folders can be protected from unauthorised changes, and you can also sync important files to (and recover them from) OneDrive cloud storage. Then there's the optional reputation-based protection against potentially unwanted apps and websites to ensure that only known-safe content can be installed or accessed.

The Windows Security interface is a pleasure to use, as are its related components. You'll find controls for real-time malware protection and on-demand scans, configuration of your ransomware protection, plus links to your firewall and parental controls (these are managed elsewhere).

Defender is focused on real-time malware protection, which it's very good at. If you want to schedule scans, however, you have to set them up via Task Scheduler. This is a chore as it involves delving into a legacy Windows interface that's in need of a revamp. Whether scheduled scans serve a useful purpose in the age of online threats is another question, but a shortcut for those who want them would be useful.

Microsoft's Family Safety parental controls are primarily web-based and

require more configuration than some rivals. But they're incredibly comprehensive and effectively balance parental protection with the rights of older children, in particular to a certain degree of privacy.

Family Safety is fully integrated with Windows, but it also provides comprehensive support for mobile devices that run Android and iOS. Features include web-content filtering, screen-time controls, Windows Store purchase protection and family location sharing. If you set up everyone in your family with their own Microsoft account – the optimal way of configuring Family Safety – all your settings are synced across every device a user is logged into. However, it's worth noting that Family Safety browser controls only cover Microsoft's Edge browser and will by default block other browsers.

Returning to malware protection, Defender will, of course, still stop malware that comes in via any browser, and if you want to use its dedicated browser protection plugins, these are available for Google Chrome, as well as the Chromium-based Edge.

On a purely practical level, you want your operating system to provide at least some kind of functional protection against malware. Although the integration of Defender into Windows gives it an arguably unfair advantage against commercial rivals, in the same way that Windows users are now aggressively encouraged to use Edge, Defender's reliability means that you can install Windows and immediately go online without

The bright screen has a refresh rate of 120Hz and is a real highlight.

worrying about a random drive-by download dropping malware the first time you visit an ad-infested media site.

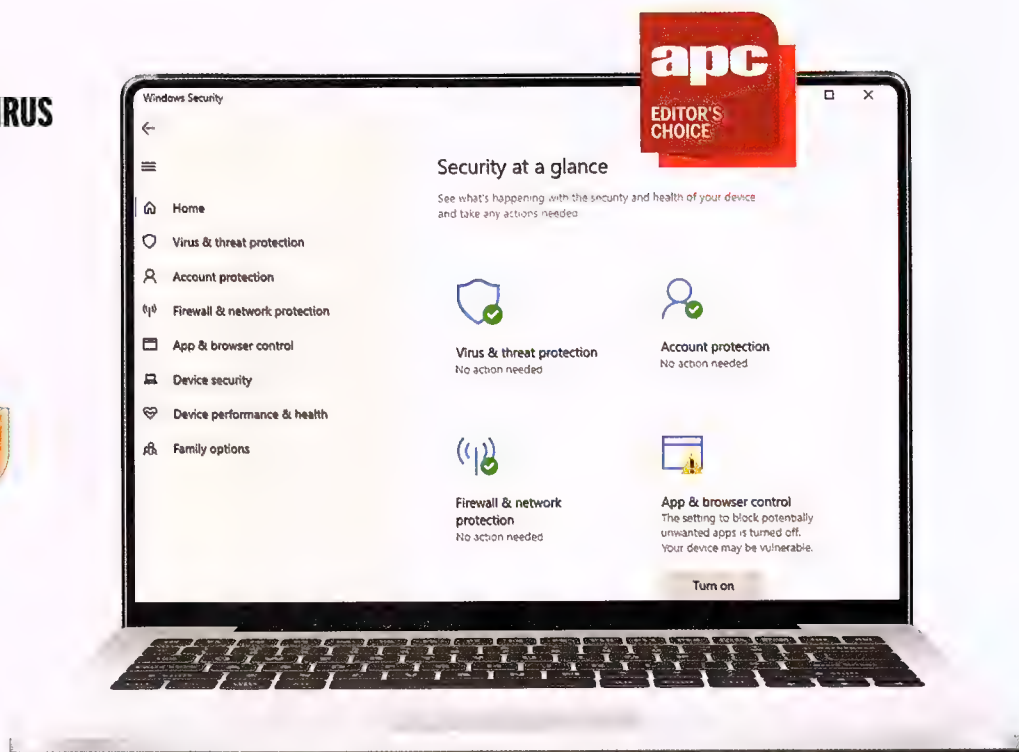
It's also extremely low maintenance and requires minimal user interactions, which means you can trust it not to go wrong in the hands of inexperienced users.

This wide adoption also means that Microsoft gets plenty of opportunity to collect samples of the latest malicious files. Despite this, Defender's performance in anti-malware testing tends to vacillate somewhere between decent and perfect; it's not as consistent as some of its rivals. Still, it aced the latest tests from AV-Test and SE Labs with perfect protection scores, and a 99.5 percent defence rating with seven false positives in AV Comparatives' most recent detection test.

AV-Test also found that Defender can have a bigger impact on system performance than its rivals. This is particularly visible on low-spec systems when they install applications and copy files, where rivals such as Avast have much less of a footprint.

Note also that, if you're running legacy Windows 7 systems, you'll need to use a different antivirus solution, such as Avast or G Data, as Microsoft no longer supports its older OS with security updates. And Defender for that older OS was a less comprehensive solution in the first place.

For most users concerned about how to best keep Windows safe, Defender does the job as well as anything else unless you have specific requirements.





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techradar.com

How to keep small enterprises protected

This group test focuses on consumer protection, but similar tools are available for all sizes of businesses – including Microsoft's own SMB protection.

There's a growing divide between both the companies that provide anti-malware services to home and business users, and the methods they use to deliver them. However, this can leave small business users overwhelmed by choices that seem targeted at much larger enterprises.

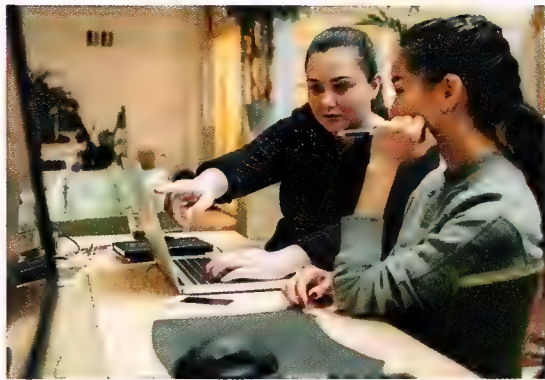
The model for home users is primarily still a per-device approach. Perhaps there's a modest web-based management interface to show which devices are connected to your licence and, in the most sophisticated examples, a summary of what threats they've found. But that's your lot.

Enterprise security is focused on comprehensive endpoint security, with an extensive management system that provides detailed per-device threat, behaviour and activity reporting. Endpoint security solutions often also include protection for Linux or Windows servers, and incorporate network firewall management, email protection, support for cloud servers and virtual machines.

Having all this information at your fingertips is great for security specialists at larger businesses, but the interfaces can be complex and overwhelming for smaller businesses.

Microsoft steps in

Fortunately, a number of companies provide endpoint security solutions specifically for smaller businesses. These combine features that may be familiar from consumer solutions with network deployment, monitoring and smart remediation. The aim is to stop potentially catastrophic malware such as ransomware before it



Above: There's plenty of choice for small businesses in the security market.

takes hold of multiple devices on your network.

First, check your existing licences and subscriptions. If you're on the Business Premium tier of Microsoft 365, for example, you already have a Microsoft Defender for Business subscription. Defender for Business' dashboard is one of the simplest you'll find in endpoint protection. It automates a great deal, making it easy to handle threat reports and roll out protection to everyone on your subscription.

Recent events compel us to include a caveat here: if an update goes wrong, it can have a large-scale impact, such as a recent Defender for Enterprise update that deleted users' application and Start menu shortcuts. This caused chaos. Microsoft was quick to roll out an update, but affected users' systems' couldn't be fixed automatically.

This situation is symptomatic of regularly updated software supply chains in general, but the level of integration Microsoft Defender has with Windows arguably provides more potential for things to go wrong.

Beyond Microsoft

Microsoft's pricing for SME antivirus is competitive, but it's by no means the only notable player in this space.

Avast, Bitdefender, Malwarebytes, Sophos and Trend Micro all have well-regarded small business security solutions, many of which can be bought directly without the process of obtaining individual quotes, although doing so can get you a better deal.

Avast's Business Security range starts at \$57.08 per device per year for a managed antivirus, ransomware, data protection and identity protection solution. Higher tiers cost up to \$87.94 per device per year and add features such as a VPN and patch management. There's also USB device blocking to prevent files from being taken off-site.

Bitdefender's GravityZone Business Security does a little more, with modules including email security and full disk encryption of your endpoints. Prices here scale depending on how many devices you need to protect, but start at \$293.99 per year for five devices.

Malwarebytes leans into cloud protection technologies. Malwarebytes for Teams is inexpensive, but it's also a standalone product without central management, so isn't appropriate for most office deployments. Malwarebytes Endpoint Protection starts at \$92.99 per device per year and includes USB device control, optional Windows and Linux server licensing and a sophisticated cloud management console.

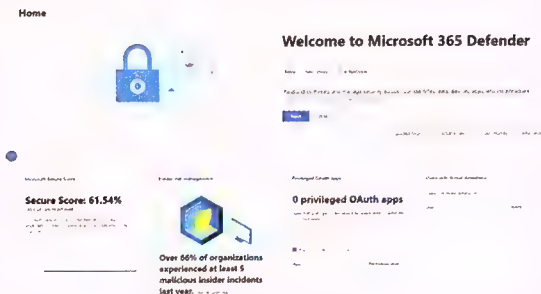
You'll have to get a quote from Sophos, but the company offers a range of SMB-oriented options, whether you require managed cybersecurity, have your own IT team in-house, or wish to deploy hardware appliances.

You'll also have to get a quote from Trend Micro, but the firm is known for scalable solutions for small and medium enterprises, with all-in-one management tools that cover endpoint, network and email security.

Business antivirus uses the same detection technology as its consumer counterparts, but provides extra layers of defence and is typically more paranoid. After all, user freedom to install whatever takes their fancy is rarely desirable in the workplace.

Just as we've used data from reputable anti-malware testing houses to assess consumer antivirus suites in this group test, similar data about enterprise anti-malware is available for free from selabs.uk, av-test.org and av-comparatives.org.

Below: Microsoft 365 Defender is an inexpensive option.



AVIRA FREE SECURITY

Solid free anti-malware, but Avira is no more effective than Windows' built-in defences.

★★★★★

Free | avira.com



Although it was bought by Norton LifeLock in 2020, Avira continues to use its own malware-detection engine. Rival firms like it too, which is why you'll find it (alongside other engines) in suites such as F-Secure, Sophos and TotalAV.

Why is Avira's engine popular? It got a perfect detection score from AV-Test in its latest roundup, albeit with five false positives. It also put in creditable results in AV Comparatives' tests, blocking 99.8 percent of malware with two false positives, and SE Labs, where it blocked 99 percent of malware with no false positives. That compares well with Windows Defender, although it scored more false positives in the AV Comparatives test.

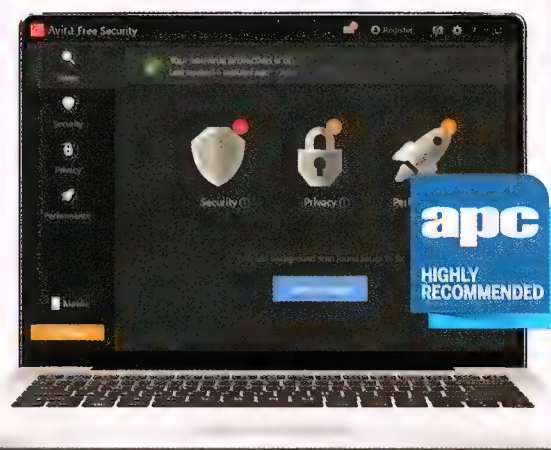
The minimalist Status tab shows you a notice that your antivirus is active, three non-interactive graphics marked Security, Privacy and Performance, and a button to

initiate a smart scan. The interface defaults to a charcoal-grey dark mode, which is perhaps less attractive than the white light mode, but is also less dazzling.

As well as checking for malware, the standard scan will offer to clear temp files and registry entries that Avira deems unnecessary, and then suggests you might wish to upgrade to a paid-for version to free more space, remove or delay slow-starting apps, update your software, monitor your email and improve your privacy.

Via a Security tab, you can run and schedule a variety of scans. Privacy is home to Avira's home-grown Phantom VPN service, but free users get only 500MB of bandwidth a month. Separate interfaces can be launched for both Avira System Speedup and Phantom VPN, but these are integrated into the main Avira install, and don't need to be removed separately if you ever wish to uninstall it.

Under Performance, you'll find system



optimisation utilities that scan for out-of-date drivers and duplicate files, plus some adverts for Avira Pro, which offers optimised power profiles, improved startup times, and a "game booster" mode for silent detection. The lack of a silent detection mode that won't bother you when gaming or watching movies is disappointing, as most free AV products now offer this feature.

Although Avira will protect you, aside from its false positive score it doesn't have many advantages over Microsoft Defender. But it's worth downloading if you want to squeeze more performance out of a low-spec PC, as it's less demanding than its rival.

BITDEFENDER PREMIUM SECURITY

As effective as Microsoft Defender, but packed with extra features, if you need them.

★★★★★

(10 devices) \$199.99 | bitdefender.com.au



Bitdefender's security suites are eminently easy to live with, from its Free Antivirus suite to this fully loaded Premium Security bundle, which includes Total Security for Windows, parental controls, a VPN and a password manager.

There's also the Bitdefender Central online management portal, where you can monitor the status of devices, find them if they're lost or stolen, and view somewhat invasive activity summaries for any child accounts that you've activated parental controls for.

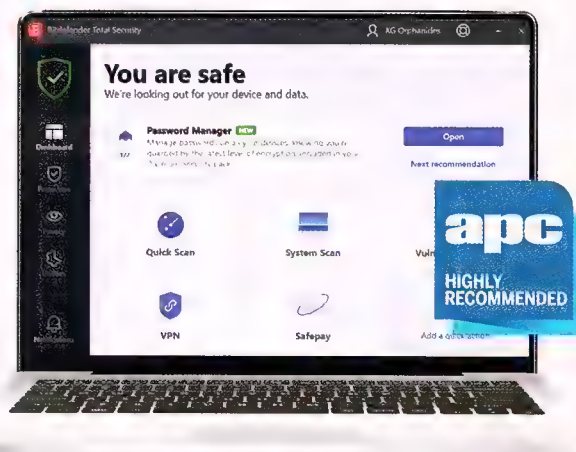
It's a capable overall package, but Bitdefender's performance in tests isn't quite as good as some rivals: it most recently got a 99 percent protection rating from SE Labs, 99.7 percent from AV Comparatives, and while it detected all malware in AV-Test's latest tests, it registered a few false positives.

The client's main page shows the status of your real-time protection and provides shortcuts for scanning, a VPN, a secure browser and a customisable quick action for anything you might use regularly.

Protection tools include a dedicated firewall, email scanning, web content protection, whitelist-based webcam and mic protection, and a Ransomware Remediation module that creates a local backup of files when it detects an untrusted program trying to access them.

There's also a secure file shredder, system optimiser and Safepay, a hardened browser for online financial transactions. And silent detection modes are automatically enabled when Bitdefender spots you watching something at full screen or playing a game. They can also be activated manually, and even configured to halt Windows Updates.

Standalone components such as the VPN



– a white-label version of Hotspot Shield – and password manager are installed separately, via shortcuts in the main desktop client. Like most bundled VPNs, you can only use the VPN via Bitdefender's apps. Bitdefender's home-grown password manager is perfectly effective, and its extensions have a pleasing interface that's reminiscent of 1Password.

If you like the Bitdefender interface and package there are good reasons to choose it (although look at McAfee or Norton 360 Advanced too), especially at its first year price. But watch out for that expensive auto-renewal.

ESET INTERNET SECURITY

Mid-range, mid-price security software with no extraneous matter or steep second-year price rises.

★★★★☆

(5 devices) \$79.95 | from eset.com



Eset is perhaps better known as a provider of enterprise-oriented endpoint protection, which is why its home security suite feels like it means business.

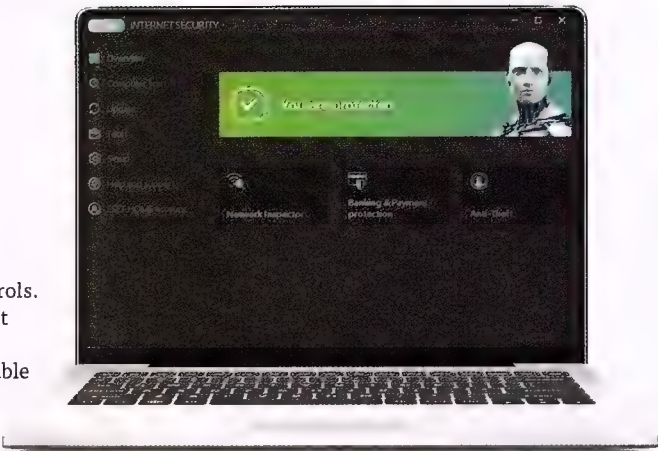
This extends to its excellent levels of protection. Eset's historical performance in AV-Test's suite of tests has been excellent (although it hasn't been tested recently) and AV Comparatives' latest results – a 98.9 percent rate of malware blocking with a single false positive – is respectable, albeit not in the top flight of results.

There are three versions of Eset for consumers. The cheapest, NOD32, is simple antivirus for your Windows or macOS computer. Eset Internet Security, which we've reviewed here, adds Android device protection, a dedicated firewall, anti-spam, botnet protection, defence against threats on your local network,

anti-theft tracking tools for portable devices, webcam protection and parental controls.

The next tier up, Eset Smart Security Premium, adds a password manager, a removable media encryption tool and Eset LiveGuard. This latter product sends data about potentially risky unknown files to Eset's own servers for analysis within five minutes.

The interface is available in dark and light modes, and can be configured to follow system colour modes. The main overview screen informs you that you're protected and provides shortcuts to various services. A network inspector will scan your network for devices and any potential threats; the secured browser mode for banking protection can warn you about any untoward apps that might be spying on you; and an anti-theft toolkit will check your security settings and provide a honeypot "phantom account" that will take over as the main account



while your others are concealed if you mark your computer stolen.

In the Computer scan tab, the usual array of on-demand and scheduled scans is available. Almost everything else is enabled by default, with the exception of parental controls, which allow you to restrict activity by time, app, and web content type or URL.

There are some novel features here, but aside from its anti-theft tools Eset doesn't do anything that surpasses its rivals. The fact that it did fractionally worse than Microsoft Defender in AV Comparatives' latest tests seals its mid-table fate.

F-SECURE SAFE

Distraction-free protection that does the job, but F-Secure Safe doesn't stand out from the crowd

★★★★☆

(5 devices) US\$59.99 | from f-secure.com



F-Secure Safe is an unobtrusive, no-frills security suite with a small range of features. Its pared-down interface feels almost empty compared to some of the other services, but that's mostly because it doesn't try to fill space with random system optimisation tools or services better provided by a specialist.

As well as a couple of different scanning options, its modules provide integrated protection against known malicious websites, a secure banking tool and reputation tools for in-browser search (available via extensions for Firefox, Edge and Chrome).

DeepGuard is a cloud-based reputation system that only allows the installation of apps that it knows to be safe. Impressively, this didn't throw up any false positive identifications of legitimate software in recent tests. A gaming mode prevents interruptions and suspends system-intensive

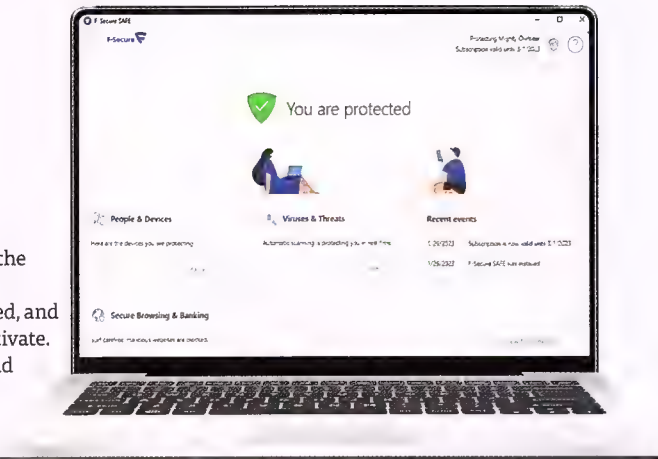
scanning tasks when you're in the middle of playing something.

Parental controls are included, and they're effective and easy to activate. Features include time limits and web filtering, but not per-app restrictions.

A more comprehensive version, F-Secure Total, also includes a password manager and the company's surprisingly capable Freedom VPN, which is developed in-house. This costs around \$10 more per year.

F-Secure's main benefit is that it doesn't bother you or really need any interaction at all. This is the same ethos we see from Microsoft Defender, and it's a good one – many end users don't want to make hands-on decisions about system security.

F-Secure combines its in-house malware detection with the Avira engine, although tests show that F-Secure's weighting and handling of threats differs from Avira's. It's tricky to say how effective it is, as the only



recent test data comes from AV-Test: here, it missed some malware in an October 2022 test, but still scored a respectable 99.2 percent for protection. This is comparable to long-term historical data from AV Comparatives, while 2021 data from SE Labs shows F-Secure detecting 98 percent of malware with no false positives. AV-Test also found that it slowed down file copies more than many rivals.

F-Secure Safe isn't as expensive as some but its performance and features don't provide a compelling reason to use it instead of Defender, or most other free and paid-for alternatives.

KASPERSKY INTERNET SECURITY PREMIUM

Effective and well-priced anti-malware that you might not be allowed to use if working from home.

★★★★★

(10 devices) \$41.95 | kaspersky.com.au



Kaspersky Internet Security is an entirely effective anti-malware solution and a politically difficult one, given that the Russian-made suite's use is restricted in many workplaces, which you may have to consider if you're a remote worker.

There's also the question of whether you wish to support a Russian firm. The Australian government has issued no guidance on the matter, while the UK's National Cyber Security Centre's March 2022 guidance states: "Nearly all individuals (and many enterprises) are not going to be targeted by Russian cyber attack, regardless of whether they use Russian products and services. If your personal laptop uses Kaspersky AV... it's highly unlikely to be directly targeted (and) it's safe to turn on and use at the moment."

If Kaspersky works for you, or you have

an ongoing subscription, there's no pressing security need to replace for Russia-specific reasons. It's still among the better performers in the tests, too. It detected all malware in AV-Test's real-world and reference tests and in SE Labs' real-world tests, with no false positives in either. It slipped a little in AV Comparatives' recent test, in which it detected 99.7 percent of malware with one false positive. It's clearly excellent protection against malware, but Avast, G Data and McAfee all performed better.

Kaspersky's product lines have recently been refined into Basic, Plus and Premium versions. A free version is no longer available. Basic is pure antivirus software, plus a firewall and system optimisation tools. Plus adds a hard disk monitor, password manager, VPN and network monitoring.

We reviewed Kaspersky Premium, which also includes 24/7 support and a



remote PC health check, a data breach monitoring service, secure storage for digital versions of your identity documents and a year's subscription to the premium version of Kaspersky's Safe Kids parental control and GPS tracking system.

Although this tier is marketed similarly to McAfee and Norton's security suites, Kaspersky conspicuously does not include a support service to help guide you through recovering from identity theft or document loss.

However, it's also a lot cheaper, with a 10-device subscription coming in at about half the price of its rivals' top-tier equivalent.

NORTON 360 ADVANCED

A powerful suite with a generous amount of cloud backup, but McAfee's equivalent wins out.

★★★★★

(10 devices) \$149.99 | au.norton.com



Like McAfee and Microsoft, Norton 360 is a market-dominating behemoth of the security world. Its top-tier Advanced subscription comes with a wealth of extra features, including online backups, credit rating monitoring and an identity theft remediation helpline.

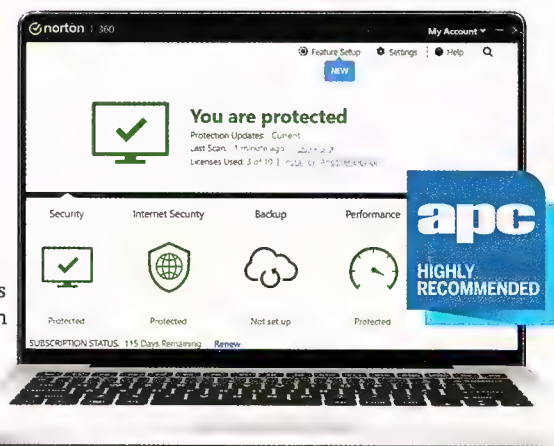
You also get a generous 200GB of cloud backup capacity that doubles as your anti-ransomware backup target, a capable parental control suite, an unlimited version of Norton Secure VPN and a password manager. While none of Norton's solutions is the best in class, they're all effective, which is handy if you want to get multiple tools wrapped up in a single subscription.

You'll also find browser protection plugins, the SafeCam webcam defence module that controls which apps have access to the device, a smart firewall, a software updater as well as

email scanning.

Norton 360's recent performance in both AV Comparatives and SE Labs tests has thrown up more false positives than most rivals. It got a perfect sweep in AV-Test's latest trials, but although AV Comparatives found it blocked 99.9 percent of malware, it also misidentified 27 benign programs or websites as malicious and required the user to weigh in on a further five. SE Labs found Norton to be perfect at identifying threats, but misidentified two percent of legitimate programs as malicious.

Norton 360 Plus has an RRP of \$75.99 and covers a single device. Standard is still a single-device subscription but throws in a VPN service, increasing the price to \$104.99. If you need parental controls, Deluxe has your back, and will cover five devices. Finally, at \$149.99, Norton 360 Advanced protects ten devices, with access to the identity restoration service. Norton offers a sizeable first-year discount, but beware the



auto renewal.

On prices and features Norton 360 Advanced is in direct competition with McAfee+ Advanced, which also includes a helpline for handling lost personal documents and identity theft, but has the added bonus of an unlimited number of installations and, at its very top tier, the ability to remove your personal information from online data brokerage sites.

While Norton 360 Advanced will keep you and your computers safe – and includes a very generous 200GB online backup service – it currently loses out to McAfee on accurate detection of legitimate software and identity-protection features.

PANDA FREE ANTIVIRUS

Free antivirus that's good at blocking threats but too twitchy around legitimate software and websites.

★★★★★

Free | pandasecurity.com



Acquired by enterprise security specialist Watchguard Technologies in 2020, Panda's antivirus offering has gone from strength to strength in recent years.

Panda's Dome client is attractive, though its icons could be clearer. The options are standard: initiating the customisable scan lets you check just critical areas such as memory and active processes for currently running malware, or you can choose your entire PC or specific folders.

The Antivirus button lets you view prior scan results, detection events and quarantined files, run a quick scan, add a scheduled scan or quickly access the settings. These settings are typical of free AV software, and include compressed file scanning, a warning before neutralising malware, adding exclusions and disabling any antivirus modules you might not want.

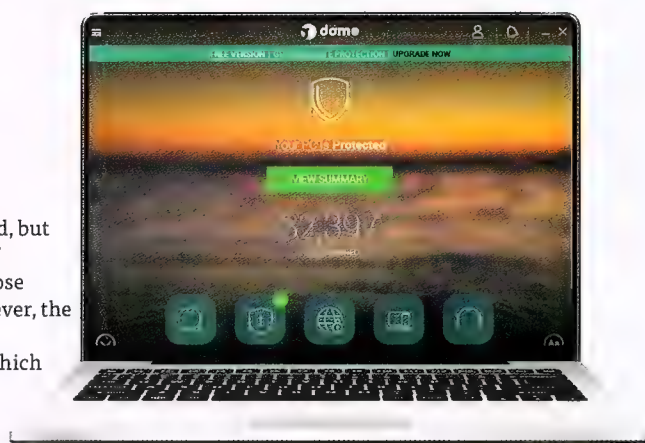
There's a VPN service, too. It's a white

label version of Hotspot Shield, but you only get 150MB per day of bandwidth and you can't choose your endpoint location. However, the client's configuration options appear to lack a kill-switch, which is critical in protecting your privacy. You should use ProtonVPN's free tier instead.

The My Devices icon encourages you to install Panda on your other Windows, macOS, iOS and Android hardware and can direct you to Panda's device-monitoring web portal, which mainly provides stolen or lost device tracking for mobile devices.

You can have Panda "vaccinate" USB drives by disabling their autorun.inf file – handy if you're still running Windows XP (which Panda still supports, to its credit), or disable automatic USB drive scanning.

A monitor can highlight potentially risky processes but has an otherwise uninspiring interface. The "View detailed



report" button provides more useful information and the ability to block processes manually, which should be done with care.

Panda's Rescue kit can burn you a bootable rescue USB drive to scan your system disks for malware while they're unmounted, and can also install and invoke Panda's Cloud Cleaner for an instant system scan.

Finally, you can see a list of your other Panda products and the protection status of the devices you installed them on. In general settings, you can enable silent detection and disable Panda's pop-ups.

Panda will protect you from malware at no cost, but it's no more effective than Microsoft Defender.

TREND MICRO MAXIMUM SECURITY

Unimpressive performance in recent tests makes this rather expensive suite hard to recommend.

★★★★★

(1 device) \$69.95 | trendmicro.com/en_a



Trend Micro packs a lot of features into Maximum Security – many of them useful – but not enough to justify its price. The usual range of real-time, on-demand and scheduled scanning is available, along with POP3 and IMAP email filtering and a botnet-detecting "firewall booster". Trend Micro also provides a browser plugin to block threats.

A ransomware protection module defends selected directories and their contents against changes by untrusted programs. There's a selection of system optimisation tools, and Trend's privacy tools are notable but don't feel like they've been updated in a while.

When we tested it, a tool to check your privacy settings on Facebook, Twitter and LinkedIn opened Internet Explorer, which no longer works in Windows 10. This

Privacy Scanner is still built into Trend's plugins for modern browsers, so opening the wrong browser is clearly an oversight.

Data Theft protection monitors the information that gets typed into web apps to prevent you from sharing anything private. There's also a secure file eraser, encrypted file vault creator, parental controls and a standalone password manager.

Mute mode, enabled by default, automatically activates when you're using full-screen mode to prevent games, presentations or films being interrupted. You can also activate it manually, have it prevent Windows Update from running and even have Trend terminate selected programs when mute modes are enabled.

Trend Micro is among the worst offenders for false positive detections of legitimate software and websites, clocking up 42 misidentifications. For nervous users, or those who don't wish to spend their time



investigating a suspect file or domain, this seriously impacts the usefulness of Trend as malware defence.

Its performance at detecting actual malware, meanwhile, was adequate. It picked up 99.8 percent of AV Comparatives' samples, 100 percent of AV-Test's September set and 98.4 percent of the October set with a single false positive.

If you're a long-time user, Trend should keep you safe enough. But if you're looking for new antivirus software then we'd recommend using something that's been shown to be more reliable recently, and that includes Microsoft Defender.

HOW WE TEST

We get hands-on with every single product in the group test, ensuring that its features and interface all work as they're supposed to and highlighting any friction points.

However, long-term testing with live malware samples is required to genuinely evaluate how effective any given antivirus solution is at protecting your system against malicious software.

For this, we turn to a trio of independent and well-regarded anti-malware testing houses. Specifically, SE Labs in the UK, AV-Test in Germany and AV-Comparatives in Austria. All three organisations publish their test data and methodologies, making them available to the public, as well as the press and industry professionals.

Data for this group came from AV-Test's report in December 2022 for home users (tinyurl.com/APC519AVT),

AV-Comparatives real-world protection test that took place between July and October 2022 (tinyurl.com/APC519AVC) and the SE Labs Endpoint Security Home test from Q4 2022 (tinyurl.com/APC519END).

We've used the most recent available test data in all cases. Where a specific product is not tested, results for products using the same malware detection engine are used. Where a product has not been tested recently by all labs, we've referred back to historic test data to provide insight into its long-term performance.

In evaluating data, we place the greatest weight on "real-world" testing, in which antivirus software is exposed to live malware samples in a realistic scenario, such as web exposure, rather than file scans of a large collection of malware samples.

We also take into account performance

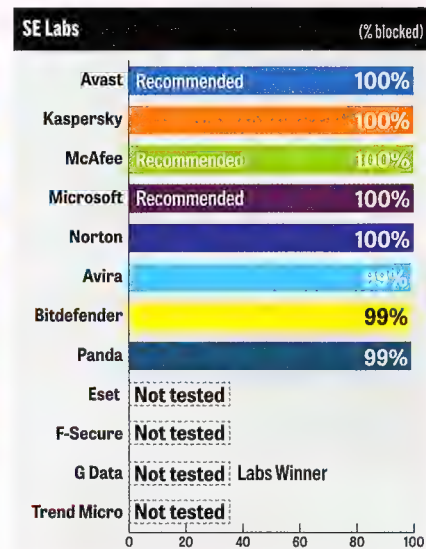
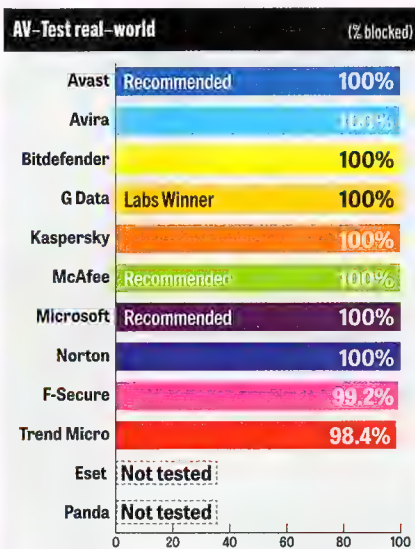
SE Labs
INTELLIGENCE-LED TESTING



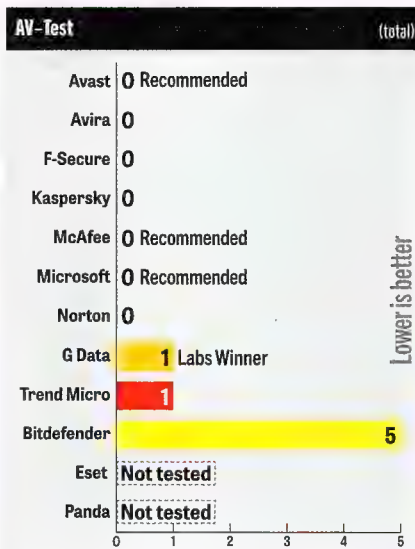
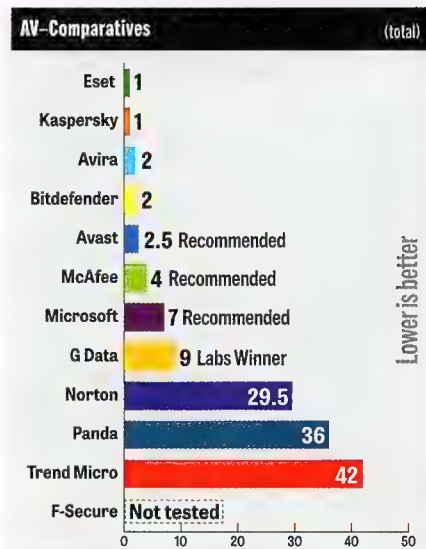
Above: SE Labs testing data helps inform our reviews.

impacts, measured by AV-Test, and false positives. False positives occur when the AV software flags a piece of software (or website) as dangerous when it isn't, or asks the user to make their own judgement. The former counts as one false positive, the latter half a point.

TEST PROTECTION



FALSE POSITIVES



View from the Labs

The family tree for antivirus software is more like a tangled bush, but it's worth trying to understand who owns whom.

The past couple of years have seen numerous mergers and acquisitions in the cybersecurity industry, as well as the definitive splitting of some big brands into separate consumer and enterprise security companies. As the saying goes, it's complicated.

Let's start with our Labs Winner, McAfee. In 2021, McAfee's Enterprise division was bought by Symphony Technology Group and merged with FireEye to become Trellix. Intel no longer holds a majority stake in the McAfee brand, which is now owned by an investment group and exclusively caters to consumers. McAfee retains its consumer-friendly subsidiaries, such as TunnelBear VPN.

Things become even more complicated when it comes to the other big hitter, Norton. When the Symantec enterprise security brand was sold to chipmaker Broadcom in 2019, the remaining consumer antivirus company, which included the Norton Antivirus and LifeLock identity protection brands, became Norton LifeLock.

Norton LifeLock went on to buy Avira in 2020, with Danish internet security outfit BullGuard brought into the fold in 2021. Norton LifeLock then merged with Avast in 2022. The resulting company is now called

Gen Digital and includes former Avast subsidiaries such as VPN provider HMA and system optimisation tool CCleaner. Gen Digital says it has no intention to change the existing brand names of its subsidiaries, which is a relief as even discerning industry watchers are struggling to keep up.

Most of these consolidated companies haven't yet merged their subsidiary technologies, but there are exceptions. At McAfee, the company's Safe Connect VPN now uses TunnelBear's infrastructure and even finally added a kill switch – a

good move given Safe Connect's previous weakness as a service.

We're more likely to see dramatic changes at Gen Digital. Long before the Norton LifeLock buyout, Avast and AVG merged detection

engines after their 2016 corporate merger. Nor is the company afraid of killing brands, with BullGuard subscribers moved over to Norton products. Meanwhile, some paid-for Avira users have seen Norton LifeLock features such as Norton's cryptocurrency miner rolled out to their Avast antivirus suite.

More consolidation seems likely. While Gen Digital has dual headquarters in the Czech Republic and the USA, it intends



The ownership of malware companies is a tangled web.

to reduce total staff numbers from 5,000 to 4,000. This could result in less choice for consumers, with potential implications for malware research if R&D teams are consolidated and reduced.

Then there's Microsoft. The increasing dominance of Microsoft's Defender in both consumer and enterprise malware protection raises questions about unfair market monopolies that we've seen before with Internet Explorer and, more recently, Edge. This could grow into one of the stories of the next decade.

On this occasion, I'm not convinced government agencies should step in. There's a strong argument that defence against malware, both through privilege access management and detection tools, is something that should be built into operating systems.

The debate is interesting (for someone) but shouldn't distract us from what really matters: effective malware defence. ■

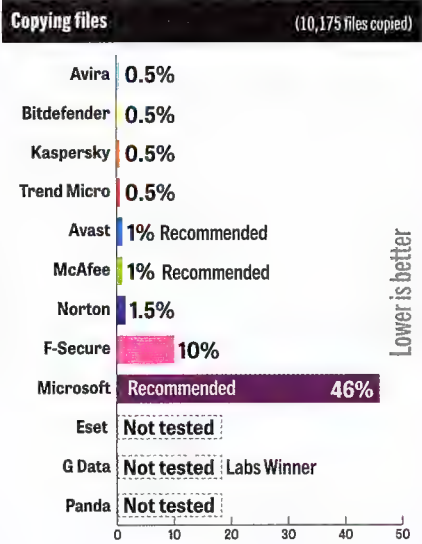
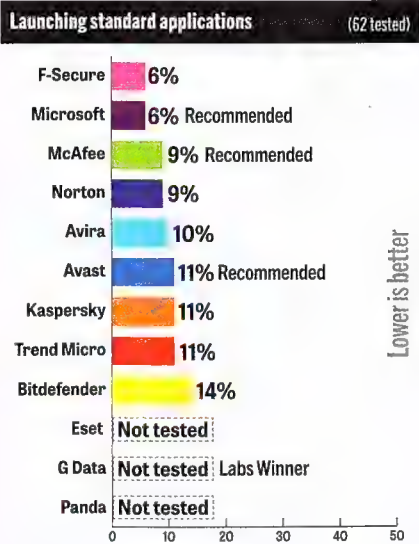
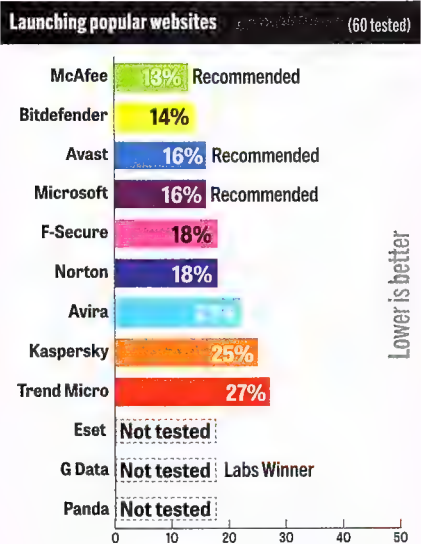


KG Orphanides specialises in security topics and provides a quarterly testing service of VPNs at vpndatatracker.com

"The increasing dominance of Microsoft's Defender in both consumer and enterprise malware protection raises questions about unfair market monopolies."

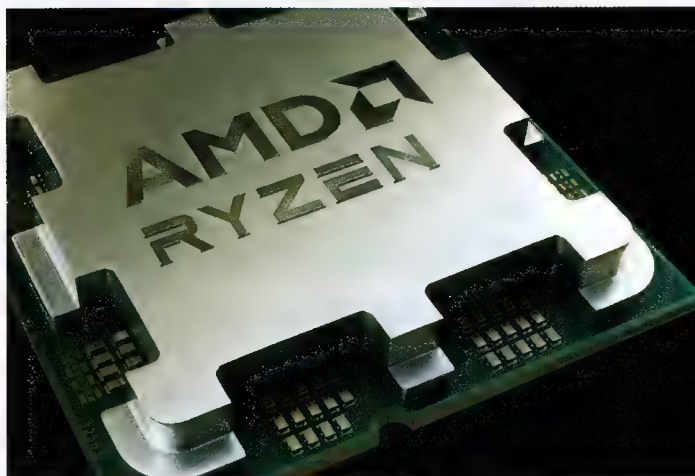
PERFORMANCE IMPACT

(Based on AV-Test's measured influence on computer speed)



System News

Would you like extra chips with that? Mark Williams analyses why more isn't always better.



Ryzen™ 9 7950X3D			
16-Core 32-Thread	Up To 5.7 GHz 4.2 GHz	144MB Cache	120W TDP

Ryzen™ 9 7900X3D			
12-Core 24-Thread	Up To 5.6 GHz 4.4 GHz	140MB Cache	120W TDP

Ryzen™ 7 7800X3D			
8-Core 16-Thread	Up To 5.0 GHz 4.X GHz	104MB Cache	120W TDP



Mark Williams
Mark is an IT professional with a strong interest in voiding warranties.

AMD launched its much-anticipated 3D V-cache enabled AM5 processors in March, but curiously left one out, the Ryzen 7 7800X3D, to be launched in April instead. As the much-anticipated successor to the 5800X3D AM4 part it seemed odd that AMD would hold back the sequel to its most popular gaming CPU, but we can surmise why.

What AMD launched was two CPUs: the Ryzen 9 7950X3D and the Ryzen 9 7900X3D. Being almost the same as the non-3D V-cache enabled parts except for the addition of an extra 64MB of L3 cache stacked on top of one of the two CCDs, doubling L3 to 128MB while taking a 500MHz hit to peak frequency as a result. The other CCD

forgoes the extra cache but maintains the same peak frequencies of the non-X3D parts. This asymmetric L3 cache layout is what AMD wanted to provide customers to give them the best of both worlds: a V-Cache enabled CCD for cache-sensitive loads (primarily games) and a CCD without V-Cache to still offer high frequencies for peak multithreaded performance.

While a good idea on paper, it leaves these two processors in a strange limbo land. Requiring twelve or sixteen cores for tasks would tend to skew users towards the regular 7950X or 7900X where all the cores run at high frequencies as productivity scenarios rarely benefit from extra cache. With these X3D parts you're compromising raw compute performance for

essentially gaming or very specific workloads.

Productivity users are better off with the now discounted, regular 7950X, and gamers are best holding off until the much cheaper 7800X3D hits shelves in April. Apart from game developers that can make use of all the cores while developing, and the V-Cache while testing their game, it's hard to envisage any other scenario where you wouldn't be better off with either the regular 7950X or much cheaper 7800X3D.

This is likely why the 7800X3D is launching a month later, to give these two Frankenstein SKUs the best chance to sell units while the hype is high before introducing the processor gamers actually want, likely killing any further sales of the Ryzen 9 X3D parts. ■

SHOP TALK

What do you think of AMD's 7950X3D? How popular is it with your customers and businesses?

Andre, JW Computers:

"I don't think the Ryzen 9 7950X3D will do as well as AMD intend. The two Ryzen 9 variants don't get additional 3D cache over the Ryzen 7. The upcoming 7800X3D is the better option when it comes to the most 3D enhancement for your money.

In all fairness, the 7950X3D and the 7900X3D haven't been around long enough yet to see how customers perceive them. It will be better suited for business and workstation use over gaming. Although, we haven't been swamped with enquiries about them yet. The 5800X3D is the real king here. I like to think of it as the 1080Ti

of Ryzens. It might have most people completely skip this generation of the 7000 series altogether."

Vicky, Umart:

"It offers slightly worse-all round performance than its 7950X counterpart due to its lower clock speeds, but for gamers, the 3D V-Cache can more than make up for that in gaming performance.

It is definitely more focused at gamers, and that's where we are seeing the most demand, but there have been some businesses enquiring about the 7950X3D."

Market Watch

A sampling of PC systems available this month.



CENTRE COM KARUZA HYDRA

\$1,999 | tinyurl.com/APC519CC

At the same price as the CPL system this offers superior processing horsepower with a 5600X CPU and beefier RTX 3070. With 8GB of VRAM the GPU might be hamstrung in titles sooner, but lowering textures or only running at 1440p or lower will keep that issue at bay.

The more powerful GPU seems to have resulted in a reduction in RAM compared to a standard 16GB though it does have a single large 1TB SSD so all-in-all not a bad compromise. With around 50 percent more graphics performance on tap and a 1TB SSD, this is the better gamers' choice of the two systems.

CPU: AMD Ryzen 5 5600X; **Cooler:** Cooler; **Motherboard:** MSI B550M PRO-VDH WIFI; **Graphics:** MSI GeForce RTX 3070 Ventus 2X OC 8GB LHR; **Memory:** 16GB Corsair Vengeance RGB RS DDR4 3200MHz CL16; **Storage:** Kingston NV2 1TB PCIe 4.0 NVMe M.2 2280 SSD; **Power Supply:** MSI MAG A650BN 650W; **Case:** MSI MAG Forge 100R Tempered Glass Black.



CPL ONLINE 12TH GEN INTEL i5 RTX 3060

\$1,949 | tinyurl.com/APC519CPL

With the APCA 2022 winner of Best Value CPU, the 12400F, inside, this system gets off to a good start, bringing good performance at a great price. Matched with an RTX 3060 this is a well-paired duo for gaming at 1080p or 1440p. The B660 motherboard will allow for future upgrades to 13th Gen CPUs so there's an upgrade path available.

32GB of RAM is very nice at this price, although it does seem to have come at the cost of SSD capacity at only 500GB, a 2TB HDD however is included to pick up the remaining mass storage slack.

With aging, low-end, last gen parts this system might feel old for gamers sooner than normal.

CPU: Intel Core i5-12400F; **Cooler:** Cooler; **Motherboard:** MSI PRO B660M-A WIFI DDR4; **Graphics:** Gigabyte GeForce RTX 3060 Aorus Elite 12GB rev 2.0; **Memory:** 32GB Team T-FORCE Zeus DDR4 2666MHz; **Storage:** Samsung 980 500GB M.2 NVMe SSD, Seagate Barracuda 2TB HDD; **Power Supply:** EVGA 700 GQ 700W; **Case:** MSI MPG Gungnir 111R.



JW COMPUTERS GMR ALBUS RTX 4070Ti

\$3,449 | tinyurl.com/APC519JW

Harry Potter fans keen to play the new *Hogwarts Legacy* game need look no further. With an included Hedwig Vinyl Pop figure, Golden Snitch light and Elder Wand included casting some Harry Potter magic on this build, not only does it look good with lots of white parts matching Hedwig, but the specifications are also magical enough to run the demanding *Hogwarts Legacy* comfortably at 90fps at 1440p at high settings and at 60fps with ray tracing enabled. Certainly, impressive at this price.

The water-cooled 5800X3D CPU punches above its price class too and will allow this system to perform well in many other gaming titles too.

CPU: AMD Ryzen 7 5800X3D; **Cooler:** CoolerMaster MasterLiquid ML240L ARGB V2 White; **Motherboard:** Nzxt N7 B550 Matte White; **Graphics:** Gigabyte RTX 4070 Ti Aero OC; **Memory:** 16GB Corsair Vengeance RGB PRO DDR4 3200MHz White; **Storage:** Kingston 1TB NVMe PCIe Gen4 SSD; **Power Supply:** Gigabyte UD850GM 850W; **Case:** NZXT H5 Flow Edition White.

NZXT PLAYER: TWO PRIME

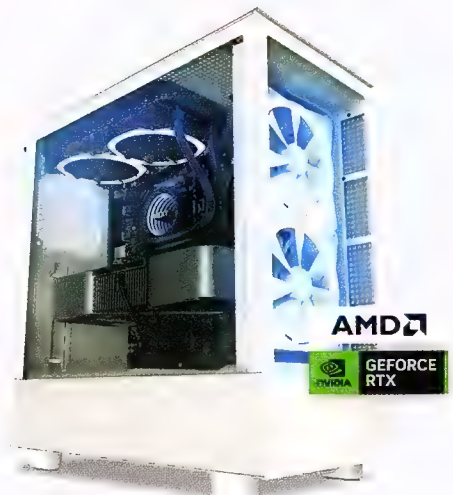
\$3,499 | tinyurl.com/APC519NZ

Coming in fifty dollars more than the JW system, this white rig is extremely similar. The 5800X CPU doesn't have V-Cache and will be the main performance differentiator when gaming, being slower by an average 25 percent when CPU bound. If you like to run your games with higher graphical settings at 120fps or thereabouts this won't be much of a problem.

The system makes up for it with a roomy 32GB of RAM, which, depending on your needs, might be of more benefit.

The 240 AIO cooler, 1TB SSD and 850W power supply round out a good gaming system that doesn't break the bank.

CPU: AMD Ryzen 7 5800X; **Cooler:** Nzxt Kraken X63 RGB; **Motherboard:** B550-based; **Graphics:** Nvidia GeForce RTX 4070 Ti; **Memory:** 32GB Team Force Vulcan Z 3200MHz; **Storage:** 1TB NVMe M.2 SSD; **Power Supply:** Nzxt C850 Gold **Case:** Nzxt H5 Elite.



Blueprints

Value- and performance-driven hypothetical builds

BUDGET

A perfect balance between price and performance.

Over the past few issues, we've been focusing on bringing the overall price tag of both budget builds down back to a more reasonable 'budget' level. Last month, we got them below the \$1,300 mark and with some further changes, we've been able to maintain a similar cost despite some increases. The challenge is maintaining a performance level while finding cheaper or older components that are still in stock. At the time of writing, everything is in stock, but this can soon change after we go to print, so we apologise in advance if it isn't. The same applies to any sale items that find their way into our builds as they run out quickly. Though correct at the time of press, sale prices can change rapidly too.

After changing lots of components in our Intel build, we were hit by a few price hikes this month. Individually, these increases aren't too bad, but together, it all adds up. To reel back some of that cash, and partly due to a stock shortage of the EVGA 450W PSU, we swapped this out for a Thermaltake Litepower Gen2 450W PSU that came in a \$19 lower. That's enough for a few snacks to keep you happy while building this thing.

On the AMD machine, we applied the same PSU change as



with the Intel budget machine. So it's out with the EVGA and in with the Thermaltake Litepower Gen2 450W PSU. Like the GPU on the other budget PC, the GPU also had a price hike. So, we added in an MSI Mech 2X OC Radeon RX 6500 XT 4GB, which helped save an additional \$110. Apart from those two changes, the AMD budget machine didn't change all that much this time around.

AMD INGREDIENTS

Part		Price
Case	Corsair 4000D Airflow	\$159
PSU	Thermaltake Litepower Gen2 450W NEW	\$55
Mobo	MSI B550M PRO-VDH WIFI	\$179
CPU	AMD Ryzen 5 5600X	\$269
GPU	MSI Mech 2X OC Radeon RX 6500 XT 4GB NEW	\$269
RAM	16GB (2 x 8GB) PNY XLR8 Gaming EPIC-X RGB DDR4 @ 3200MHz	\$88
SSD	500GB PNY CS2140 PCIe 4.0 M.2 SSD	\$55
HDD	2TB Seagate Barracuda Compute 7200	\$85
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60
Total		\$1,249

INTEL INGREDIENTS

Part		Price
Case	Corsair 4000D Airflow	\$159
PSU	Thermaltake Litepower Gen2 450W NEW	\$55
Mobo	Asrock B660M-HDV Micro ATX LGA1700	\$159
CPU	Intel Core i3-12100	\$209
GPU	Asus GeForce GTX 1660 Ti TUF Gaming EVO OC 6GB NEW	\$369
RAM	16GB (2 x 8GB) PNY XLR8 Gaming EPIC-X RGB DDR4 @ 3200MHz	\$88
SSD	500GB PNY CS2140 PCIe 4.0 M.2 SSD	\$55
HDD	2TB Seagate Barracuda Compute 7200	\$85
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60
Total		\$1,209



"Some minor changes in price were seen since last month, but were just a few dollars so we've resisted making big changes just for chump change."

MID-RANGE

A game-ready machine that can also handle demanding work.

Taking things up a notch for our mid-range build, we have a little more cash to play with and can get a punchy machine at this price point. But, much like the budget builds, we've been aiming to bring down the overall price, with hopefully some more cuts to come over the next few issues. With price increases across the board over the last year, we're having to go over each component with a fine-tooth comb while keeping everything compatible.

With our mid-range AMD build, we

had a few price changes. Some minor changes in price were seen since last month, but were just a few dollars so we've resisted making big changes just for chump change. The only significant change we made was our GPU. Out goes the Asrock Radeon RX 6750 XT Challenger Pro OC 12GB as we found an alternative Gigabyte Radeon RX 6750 XT Gaming OC 12GB for a very reasonable \$635.

On the mid-range Intel machine, we saw a few price differences on components from last time. Starting

with our CPU, the Intel Core i5-12600K, which saw a slight drop, from \$419 to \$409. Aside from that, we made two big changes, one for our GPU and one for our motherboard. Starting with the latter, we upgraded the previous Z690 Asrock Phantom Gaming ATX motherboard to Gigabyte's Z790 UD AC ATX.

As for the GPU, that was out of stock, so we swapped it out for another 3060 Ti, the Asus TUF Gaming 3060 Ti OC 8GB.

AMD INGREDIENTS

Part		Price
Case	Nzxt H7 Flow	\$209
PSU	750W EVGA 750 BP 80+ Bronze	\$169
Mobo	Asrock B650M PG Riptide WIFI Micro ATX AM5	\$319
CPU	AMD Ryzen 5 7600X	\$399
Cooler	Cooler Master Masterliquid ML240L RGB V2	\$109
GPU	Gigabyte Radeon RX 6750 XT Gaming OC 12GB NEW	\$635
RAM	32GB (2 x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	\$239
SSD	1TB Crucial P5 Plus NVME M.2 PCIe 4.0	\$145
HDD	2TB Seagate Barracuda Compute 7200	\$85
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60
Total		\$2,369

INTEL INGREDIENTS

Part		Price
Case	Nzxt H7 Flow	\$209
PSU	750W EVGA 750 BP 80+ Bronze	\$169
Mobo	Gigabyte Z790 UD AC ATX LGA 1700 NEW	\$399
CPU	Intel Core i5-12600K	\$409
Cooler	Cooler Master Masterliquid ML240L RGB V2	\$109
GPU	Asus GeForce RTX 3060 Ti TUF Gaming OC 8GB NEW	\$729
RAM	32GB (2 x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	\$239
SSD	1TB Corsair MP600 PRO NH M.2 PCIe 4.0	\$145
HDD	2TB Seagate Barracuda Compute 7200	\$85
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60
Total		\$2,553



"One of the first components we focus on is the GPU. Typically the most expensive part of any build, they often dictate the overall cost."

TURBO
The maximum PC.

Here come the big shots, our Turbo machines. Boasting good looks and powerful performance, these standout machines are where we're least concerned with cost. That said, it's still important to keep tabs on price changes so we can be sure we're getting the best value for money on the market.

One of the first components we focus on is the GPU. Typically the most expensive part of any build, they often dictate the overall cost. On the AMD front, our Turbo machine houses the XFX Speedster MERC 310 Black Edition Radeon RX 7900 XTX 24 GB GPU, and that fell by a small but welcome \$100

since last month. It's still just about the the cheapest Radeon RX 7900XTX card available, boasting higher boost clock speeds of 2,615MHz compared to similar cards with boost clock speeds of 2,525MHz. The other parts and prices remain steady. Our Asrock X670E PG Lightning is still the cheapest X670E motherboard.

Those components are also found in our Intel Turbo machine, so the same price changes apply. We bring in a new GPU, the Asus TUF Gaming GeForce RTX 4090 24 GB, which saves \$200 on our previous Asus GeForce RTX 4090 TUF Gaming OC 24GB. And that's not the only great saving we made here

- our monstrous Intel Core i9-13900K CPU falls from \$929 to \$859, bringing a \$129 saving. We also decided to bring the Z790 board that we included on our mid-range Intel machine - the Gigabyte Z790 UD AC ATX LGA 1700 - over to this Turbo rig. Other than that, the rest of the build stays the same.

So then how much do we save on both builds? With the AMD Turbo rig, we made a small saving of \$100, but the Intel Turbo rig drops by \$230. That's still nearly \$1,540 more than the AMD, but most of that comes down to the cost of the RTX 4090 cards.

Some things just don't change. Sigh!

AMD INGREDIENTS

Part		Price
Case	Phanteks Enthoo Pro 2 Tempered Glass	\$279
PSU	1,000W Corsair RM1000 80+ Gold	\$299
Mobo	Asrock X670E PG Lightning ATX AM5	\$449
CPU	AMD Ryzen 9 7900X	\$689
Cooler	Cooler Master MasterLiquid ML360R RGB 66.7 CFM 360mm	\$159
GPU	XFx Speedster MERC 310 Black Edition Radeon RX 7900 XTX 24GB	\$1,799
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	\$420
SSD	1TB WD Black SN850X M.2 PCIe 4.0	\$189
HDD	6TB WD Blue 5400 HDD	\$189
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60
Total		\$4,532

INTEL INGREDIENTS

Part		Price
Case	Phanteks Enthoo Pro 2 Tempered Glass	\$279
PSU	1,000W Corsair RM1000 80+ Gold	\$299
Mobo	Gigabyte Z790 UD AC ATX LGA 1700 NEW	\$399
CPU	Intel Core i9-13900K	\$859
Cooler	Nzxt Kraken X73 73.11 CFM 360mm	\$279
GPU	Asus GeForce RTX 4090 TUF Gaming OC 24GB NEW	\$3,099
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	\$420
SSD	1TB WD Black SN850X M.2 PCIe 4.0	\$189
HDD	6TB WD Blue 5400 HDD	\$189
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	\$60
Total		\$6,072

PC GAMER

THE GLOBAL AUTHORITY ON PC GAMES

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visit us online every month.**

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www.pcgamer.com

RESTORE YOUR OLD PHOTOS & VIDEOS

Don't pay to repair damaged photos and poor quality videos. Robert Irvine reveals how to master the most effective free methods, to preserve your precious memories forever.



WHAT YOU CAN DO

- Apply realistic colour to old black-and-white photos
- Remove scratches, rips and blemishes from pictures
- Enlarge small images without distortion by 'upscaling' them
- Scan old photos for free using your phone's camera
- Remove unwanted people and objects from shots
- Sharpen blurry and grainy old videos for free
- Reduce background noise in your home movies

There are few things more heartwarming than looking through old photos of family members and friends, particularly when the people in them are no longer with us. But these memories can be marred by the poor condition of those pictures that have become faded and damaged over the years.

Digitising your precious photos by scanning them into your computer allows you to preserve them against further damage and loss, but it won't fix wear and tear, or address problems with the original shots.

Thankfully, it's now easier than ever to restore your old photos without needing to pay for a professional retouching service. The same applies to

vintage videos captured by old camcorders that are considerably lower quality than the footage shot by modern smartphones. This is because a growing number of online tools can repair your old snaps and videos using AI technology, while powerful PC software lets you perform finer adjustments on your desktop.

In this feature we reveal how to use new, free tools to restore your old photos and videos, and explain the pitfalls you need to watch out for.

To illustrate our advice, writer Robert Irvine rifled through several shoeboxes of old family snaps that needed restoring, and dug out some old holiday home movies shot on a cheap digital camcorder.



RESTORE OLD PHOTOS USING FREE AI TOOLS

Colourise black-and-white photos

Some people regard colourising old black-and-white photos as needless modernisation. But as the world has always been in colour, it's interesting to see an approximation of how our ancestors really looked – from their skin tones to the shades of their clothes.

There are lots of online tools that use AI to colourise old photos with a single click, but most require you to buy credits or a subscription to download the processed image without a watermark.

One of the best free services is Colorize (imagecolorizer.com), which has fewer restrictions than many paid-for options and produces decent results very quickly. It lets you colourise JPEG and PNG photos of up to 5MB in size – with a maximum resolution of 3000x3000 pixels – without creating an account.

Simply upload the image (see the Before photo of my family on holiday in Weymouth in the 1950s, above right), click Start to process it – or Edit to tweak it first – then click Download to open the result (see the After photo) in a new tab. Right-click this and choose 'Save image as' to download the colourised photo (without a watermark) to your PC. Colorize also offers free apps for Android and iOS (imagecolorizer.com/app.html), but to colourise more than five images you need to pay a US\$6 a month for a subscription.

An even better AI tool, which launched last year, is Palette.fm (https://palette.fm). This offers more than 20 colour filters to experiment with and produces incredibly vivid and accurate results. It also identifies the subject of your shots to apply the most suitable colours, and lets you edit its text prompts if it gets any details wrong. On the downside, Palette.fm's free option limits you to processing low-resolution photos of 0.5 megapixels – higher resolution images require you to buy

BEFORE



Colorize transforms your old black-and-white photos to colour versions for free.

AFTER



credits. However, you do get one free HD download when you sign up for an account.

Sharpen blurry faces in photos

One benefit to using a digital camera, including the one in your smartphone, is that if unexpected movement or your shaky hand makes someone appear blurred in a photo, you can quickly take another shot. With older photos, when the blur would only be evident once the film was developed, this obviously wasn't possible, but it's now easy to fix the problem using AI.

Launched in January, the new online tool RestorePhotos.io (www.snipca.com/44855) sharpens blurred faces in pictures for free. Click the 'Restore your photos' button (see screenshot below) then 'Upload an image' and select the blurry shot. The site will then use AI to detect and sharpen the subject's face, and display the result next to the original photo. You can also click Compare to use a slider to compare the changes. Click 'Download Restored Photo' to save the image – there are no limits on the file size or the number of photos you can fix.

If RestorePhotos.io can't unblur your photo, try Vance AI Image Sharpener

(vanceai.com/sharpen-ai/). Although this requires you to register for an account to download processed images, it gives you a few free credits before you sign up for a monthly plan or buy credits. The site offers Sharpen modes for different types of blurring (motion, lens and soft) and its results are pretty impressive – though they're watermarked unless you pay (100 credits costs US\$4.95 – about \$8.80).

Clean up blemishes and scratches

Some old photos are marred by physical damage rather than problems with the shot, including tears, stains and scratches. Although AI can't repair these blemishes on the original prints or negatives, it can work its magic on the digitised versions.

One of the simplest tools to try is Hotpot's AI Picture Restorer (hotpot.ai/restore-picture), which is free for non-commercial use. This promises to "automatically remove scratches, transforming damaged photos into cherished memories", and works with both colour and black-and-white snaps. Click 'Upload' to select a picture, specify whether it has a scratch then click Restore. After 30 to 90 seconds, a small preview of the repaired photo will be displayed, which you can click to download the full-size version.

If you're unhappy with the result, another good free option is GFP-GAN (github.com/TencentARC/GFPGAN), which stands for Generative Facial Prior – Generative Adversarial Network. This new online tool uses the latest AI technology to fix blemishes and other problems in photos by identifying and replacing anomalous pixels. You can try it with example images before uploading and restoring your own, and download full-resolution versions without watermarks or restrictions.

Be aware that severely damaged and low-resolution photos may result in the tool's AI – which is still being developed – altering the subject's facial features.

In our restored picture above (my

RestorePhotos.io uses AI to sharpen blurred faces in old pictures for free.

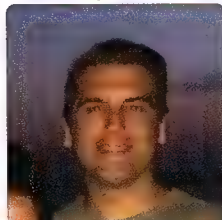
Restoring old photos using AI for everyone.

Have old and blurry face photos? Let our AI restore them so those memories can live on 100% free - restore your photos today

Restore your photos →

Restore your photos →

Original Photo



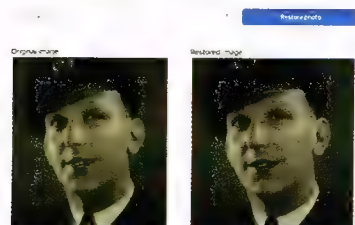
Restored Photo



Photo restoration with GFP-GAN

Source: <https://www.gfp-gan.com/>

Upload your photo and wait for the results. The results are shown in the gallery. You can download the restored photo or share it on social media.



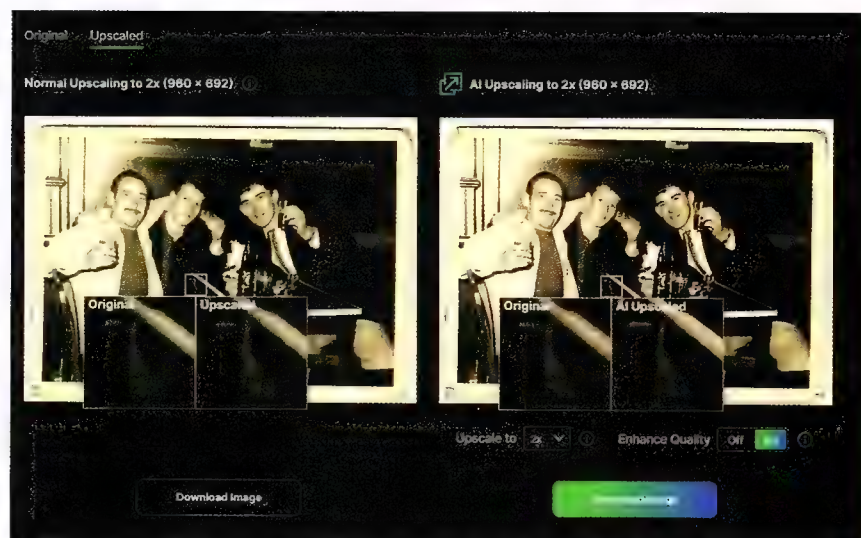
GFP-GAN restores damaged photos for free but leaves skin looking unnaturally smooth.

grandfather in the Royal Navy), GFP-GAN cleaned most of the creases and scratches, and sharpened and brightened the image, but it also made my grandfather's skin look unnaturally smooth.

Resize images without losing quality

Another problem you may encounter with old photos is that the original prints are comparatively small – often only 2.5 by 3.5in. Scanning vintage pictures – or ideally their negatives – at maximum resolution will preserve most of their quality, but if you obtain them from other sources they may become blocky when you enlarge them.

There are several AI tools that can increase the resolution of old photos without sacrificing their quality – a



Upscale.media enlarges old photos without sacrificing quality but limits file size.

process called 'upscaling' – but again you typically need to pay for unlimited use.

The best free option we've found is **ImageEnlarger.com**, which looks a little rough but is simple to use and doesn't require an account. Upload an image of up to 5MB then specify how large you want to make it – the easiest way to do this is to enter a zoom factor. The site can upscale photos to a width or height of up to 4,500 pixels, which should be enough for most pictures. It displays six results, each with a different filter applied – click the one you like best to download the enlarged photo in JPEG or PNG format.

A slicker if more limited alternative is Upscale.media (www.upscale.media), which offers paid-for plans for professionals but is free for personal use. Upload an image of up to 1500x1500 pixels, choose to make it up to four times larger and flick the switch to Improve Quality.

The results are excellent, and comprise Normal Upscaling and AI Upscaling versions, which you can hover your mouse over for closer inspection.

Downloaded images aren't watermarked, but the output resolution and size are restricted to 1500x1500 pixels and 25MB.

DIGITISE YOUR OLD PHOTOS FOR FREE

The traditional way to digitise old photos is to use a flatbed scanner or all-in-one printer, and either the software it came with or a third-party program such as VueScan (www.hamrick.com). But if you don't have access to one, and can't afford to pay for a professional scanning service, you can digitise your photos for free using your smartphone's camera.

Google's excellent free PhotoScan app for Android (www.snipca.com/44869) and iOS (www.snipca.com/44871) makes scanning photos incredibly easy and produces impressive results. It removes glare from glossy prints, detects the edges of images and crops them accordingly, and applies smart rotation to keep your pictures the right way up no matter which way you scan them.

To use PhotoScan, hold your phone over a photo until it fits in the onscreen frame, then press the shutter button. Four white circles will now appear on your screen. Move your phone so that the selection ring (see screenshot) surrounds each one in turn.

Once this is done, you'll see a green

tick confirming that the photo has been scanned. Tap the thumbnail image in the bottom right to view the result. All scanned pictures are automatically saved to Google Photos, so you can edit them on your phone or in your PC browser.

It's also possible to digitise old negatives and slides using your phone's camera. The best completely free app (as opposed to a free trial) is Kodak Mobile Film Scanner for Android (www.snipca.com/44875) and iOS (www.snipca.com/44876).

It's designed to be used with Kodak's lightbox of the same name, but you can cheat by displaying a bright white background on your laptop, tablet or another phone to use as a light source. Place the slide or negative on the screen of the device (or preferably just above to avoid pixelation), select the type of item to scan and press the shutter button in the app.

Kodak Mobile Film Scanner offers basic editing functions for cropping your scans and adjusting the colour and contrast.





RESTORE OLD PHOTOS USING FREE SOFTWARE

Although the online tools we've recommended delete your photos automatically after a set time, you may feel uncomfortable uploading personal photos – even if they'll only be seen by AI. Also, as we've explained, many 'free' image-restoration services restrict what you can do without paying. Using a free image-editing program gives you greater control over the adjustments you make and keeps your pictures private until you share them.

Paint.NET (getpaint.net), is one of the most versatile yet easy-to-use image editors, and – unlike Adobe Photoshop – it's completely free. Here's how to use the software to restore your old photos to their former glory.

Improve brightness, contrast and colours

Whether a photo has been affected by age or poor storage, or it hasn't been scanned at optimum quality, Paint.NET offers plenty of tools for making the picture look its best. The quickest way to fix problems such as unnatural colours and poor exposure is to click the Adjustments menu and choose Auto-Level, but the results aren't always great.

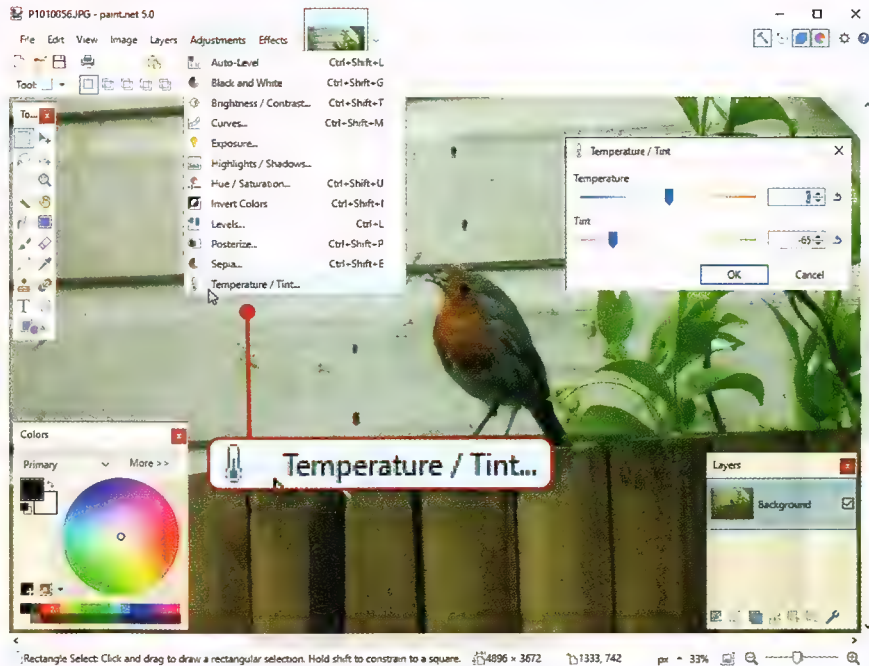
It's better to use specific options in that menu, including Brightness/Contrast, Exposure and Hue/Saturation, which offer sliders for fine-tuning the lighting and colour of your images, and the contrast of faded shots. Particularly useful is Paint.NET's new Temperature/Tint option (see screenshot above right), which lets you fix the yellow and blue tints that often plague old colour photos.

Repair your damaged photos

Rather than hope that AI can repair creases, scratches and rips, you can fix damaged photos yourself using Paint.NET's Clone Stamp tool. Click this option in the Tools toolbar on the left (1 in our screenshot below left), then click an area of your photo that looks very similar to a damaged section.



Use Paint.NET's Clone Stamp tool to remove blemishes from old photos.



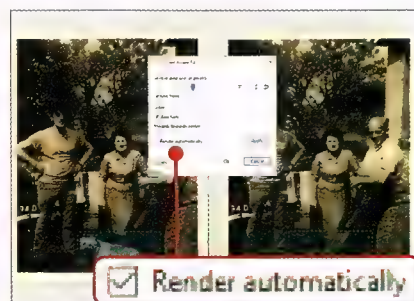
Paint.NET makes it easy to fix colour and lighting problems in your old photos.

Select a Brush size of around 40 and a hardness of about 80 in the toolbar across the top of the main window. Now click the damaged area of your photo and you'll see that the blemish is painted over.

If the damage to your photo is severe, it may be obvious that you've simply cloned one part on top of another. If this is the case, press Ctrl-Z to undo the initial change, then click the More button in the Colors panel (press F8 if you can't see this) and change the 'Opacity - Alpha' setting to 60 (2). This will make cloned pixels more subtle when you use Clone Stamp again. To make even finer adjustments, try reducing the brush size.

Remove unwanted objects and people

You can also use Paint.NET's Clone Stamp tool to remove unwanted objects and people from pictures. This is handy for airbrushing



Paint.NET's Content Aware Fill plug-in removed the dog from this old photo.

strangers and estranged relatives from history, but the process is more delicate than getting rid of a crease or blotch.

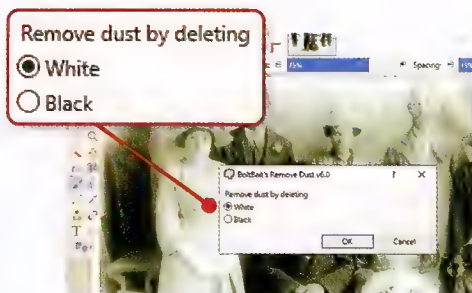
An easier option is to use the plug-in Content Aware Fill, which you can download from www.snipca.com/44864. Extract the contents of the ZIP file and drag the 'ContentAwareFill.dll' file to the C:\Program Files\paint.net\Effects folder on your PC. Restart Paint.NET, open the photo you want to edit and select the object or person you want to remove using the Rectangle, Lasso or Ellipse Select tool. Click the Effects menu and choose Selection then the new Content Aware Fill option.

In the window that opens, specify the 'Sample area size' in pixels and whether to sample from the sides, top and bottom, or all around the unwanted element. Choose a 'Fill direction' – random, inward toward centre or outward from centre – and either tick 'Render automatically' (see the photo of my Dad and grandparents, below left) or click Apply then OK.

The person or object will now be removed from the photo and the area filled in with similar surrounding pixels. The rendering process can take a while, and you may need to apply the effect more than once, but it's easier than using Clone Stamp.

Remove dust from old photos

Dust is another problem that affects old photos, whether it's on the actual

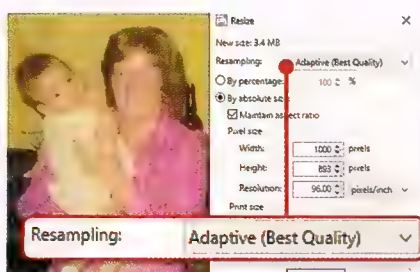


If Paint.NET can't remove dust from old photos, install the Remove Dust plug-in.

prints, the scanned copies or the original camera lens. Paint.NET offers a simple option for reducing the amount of dust – or 'noise' – in your pictures. Click the Effects menu and select Noise then Reduce Noise. Move the Radius slider to specify how many pixels will be sampled to determine the amount of noise, then use the Strength slider to set the power of the effect. The higher the value, the more noise will be removed.

If that doesn't work, download the BoltBait plug-in pack from www.snipca.com/44866, extract its contents and run the EXE file – click 'More info' then 'Run anyway' if you get a SmartScreen security warning. Select the effect 'RemoveDust.dll' (you can deselect the other options), agree to the terms and conditions and click Install Selected.

Reopen Paint.NET, click the Effects



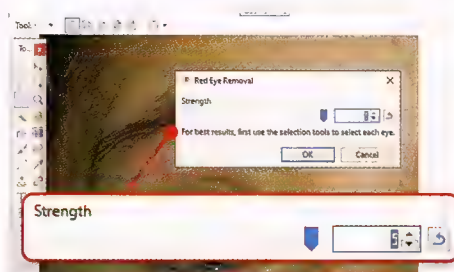
Enlarge images while preserving quality using Paint.NET's Resize option.

menu and select Photo then Remove Dust. You can then choose whether to remove white or black specks of dust from the picture (see screenshot below).

Upscale small photos without distortion

Although Paint.NET doesn't use clever new AI techniques, it does a good job of enlarging photos without distorting them and – unlike online tools – there are no limits on the image size or resolution.

To upscale an old picture, either click the Image menu and choose Resize or press Ctrl-R to open the Resize window. Select 'Adaptive (Best Quality)' in the Resampling menu (see the photo of me and my godmother below) and ensure the options 'By absolute size' and 'Maintain aspect ratio' are enabled. Specify a new width or height for the



Remove red-eye from people's pupils in old photos using a Paint.NET effect.

photo in the 'Pixel size' or 'Print size' boxes and the other settings will adjust accordingly, with the new file size shown at the top of the window. Click 'OK' to enlarge the image with minimal loss of quality.

Remove red-eye from photos

One advantage of smartphone cameras over traditional ones is that the weaker flash means red-eye is less common in photos.

Nothing ruins an old family picture like someone looking demonic, but thankfully Paint.NET makes red-eye easy to fix. Select a red pupil using the Ellipse Select tool, click the Effects menu and choose Photo then Red Eye Removal.

Set the strength of the effect (see screenshot above) and click OK to apply it – for extreme cases you may need to repeat this.



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RESTORE OLD PHOTOS USING FREE TOOLS

Colourise old black-and-white videos

Transforming videos shot in black and white into realistic colour versions is much trickier than colourising photos, because it involves a moving target and multiple frames per second. AI makes the process easier and cheaper than manual colourisation, but there currently aren't any tools that colourise videos for free. The closest we've found is Pixbim Video Colorize AI (pixbim.com/film-colorization), which offers a fully functional free trial.

Enter your email address on the website to access the download page and click the appropriate link, depending on whether your PC has an Nvidia GPU. Once the 1.2GB file has downloaded, install and launch the program, and either drop your video into the area on the left or click Load Video to select it.

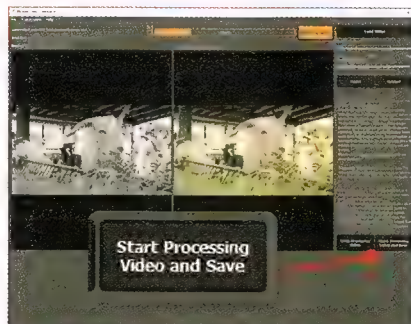
Click the 'Start Processing Video and Save' button in the bottom-right corner (see screenshot above right) and click Save to colourise your video. You can adjust the colour factor and reduce red tones using the sliders at the top right. The results are impressive but your colourised videos include a Pixbim.com watermark. To remove this and keep using the software beyond the seven-day free trial, you need to buy a licence for US\$60.

Sharpen blurry and grainy videos

Disappointingly, Opera's new Lucid Mode for sharpening blurry videos doesn't work as promised. Indeed, you should be sceptical of any free tool that claims to make videos clearer in one click – for reliable 'unblurring', you inevitably need to pay for professional software.

One simple free option is the online tool Clideo Video Cleaner (clideo.com/video-cleaner), which admits that it "isn't a miracle formula", but does make a noticeable improvement to picture quality.

Click 'Choose file' to upload a video from your PC or phone, or import one from Google Drive or Dropbox. Use the sliders to the right of the video to adjust the brightness, contrast and saturation, and apply a fade or vignette effect, to see what difference it makes. The site suggests that increasing the brightness level and bringing the contrast down a bit is the best way to reduce blurriness, but it's worth experimenting. Click 'Export' to download the hopefully sharpened video. This includes a 'Clideo.com' watermark in the bottom-right corner, which isn't too obtrusive – you can remove it by subscribing to Clideo Pro for US\$9 a month.

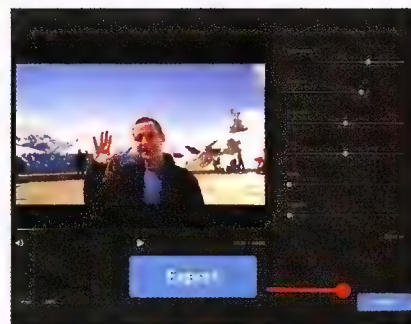


Pixbim Video Colorize AI transforms your black-and-white videos into colour.

A more powerful solution for removing blur is to use the free video editor Avidemux (avidemux.sourceforge.net). Download the Windows installer (64bit only) from www.foosshub.com/Avidemux.html, and install and launch the program.

Click 'File' then Open to select your video, and choose an encoder format in the Video Output dropdown menu, such as 'Mpeg-4 AVC (x264)'. Click the Filters button to open the Video Filter Manager, select Sharpness (1 in our screenshot below) and choose a sharpening filter – Asharp and 'Wavelet sharpener' are the best options. Right-click it then click Add to open a window that applies the filter to your video – click the Play button to see it in action. Experiment with the Strength (2) and Radius sliders, and tick the 'High quality' box to get the sharpest picture possible – click the Peek Original button (3) to compare the changes with the original video. Click OK then Close to save and exit, or undo your adjustments by right-clicking a filter and choosing Remove.

You can also use Avidemux to remove



Clideo Video Cleaner lets you adjust various sliders to reduce blur in videos.

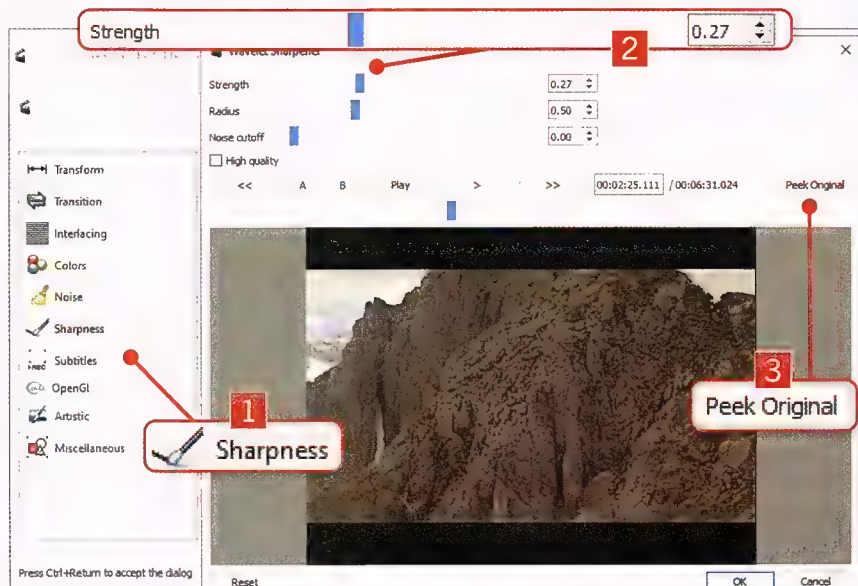
noise from old videos and make them look less grainy. Open the Video Filter Manager, select Noise and choose a filter – we recommend 'Wavelet denoiser'. Adjust the Threshold and Softness sliders to smooth the picture quality of your video, without making it look washed out. Try combining a Sharpness filter with a Noise one to achieve the right balance of grain-free detail.

When you save the sharpened video in Avidemux, be sure to select the correct video format in the Video Output menu, for example MP4 Muxer for MP4 videos.

Stabilise camera shake in videos

Unless you position your camera on a tripod or have a very steady hand, it's hard to avoid a certain degree of shake when shooting videos. It's a particular problem with old home movies, and can make you feel a bit queasy when watching them.

Oddly, YouTube – where you're most likely to see shaky videos – removed its picture-stabilisation feature a few years ago, but there are lots of free



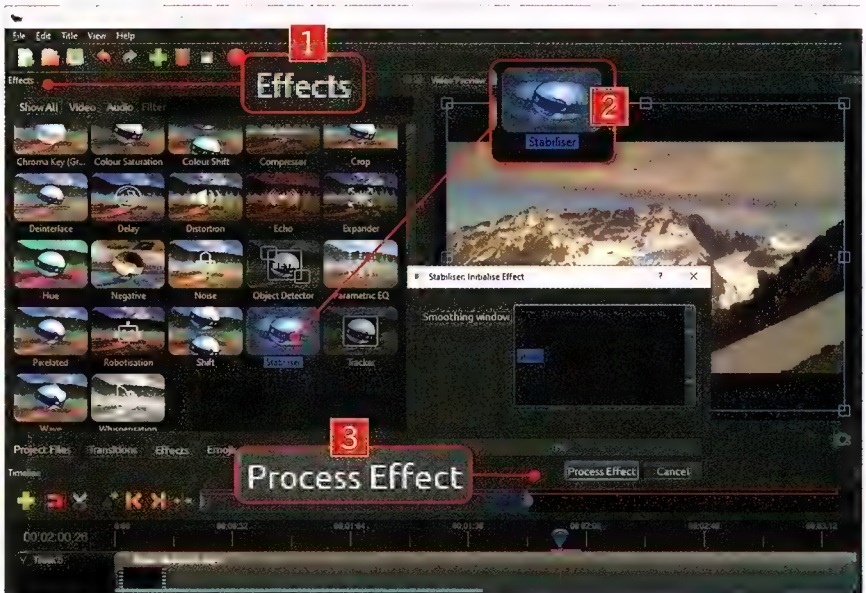
Use Avidemux filters to sharpen old videos and make them less grainy.

tools that can reduce camera shake. For example, you can upload your video to Online Converter's Stabilize Video page (www.onlineconverter.com/stabilize-video) – provided it's less than 200MB in size – then choose a Stable level and click Stabilize. The site will quickly convert the clip to a less shaky version and provide a download link. It supports most video formats and deletes uploaded files after 24 hours.

If that doesn't work, try downloading the free program Video DeShake (www.av2video.com/video-deshake.htm). This hasn't been updated for a few years and doesn't support mobile video formats such as 3GP, but it's easy to use and has no file-size limits. Simply click the plus sign to add your shaky video, select the format to convert it to and click the Deshake button. You can convert several videos at once and go into the tool's Options (via the File menu) to specify the shakiness level and how much smoothing you want to apply.

Alternatively, one of our favourite free video editors, OpenShot (www.openshot.org), now includes an option for eliminating camera shake. To use it, click the Effects tab (1 in our screenshot above right), choose Stabiliser (2) and drag the effect to the start of the clip on your timeline. Specify the strength of the smoothing then click Process Effect (3). You may need to adjust the borders of the processed video if the Stabiliser effect has realigned the picture.

Avidemux also has a stabilise feature – select Transform in the Video Filter Manager, right-click the Image Stabilizer filter and choose Add to experiment with it.

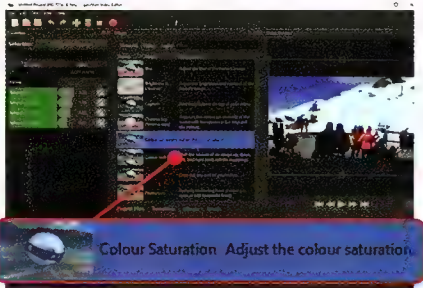


OpenShot's new Stabiliser effect detects and reduces camera shake in videos.

Correct the colours in old videos

Although you can use an online tool to adjust the colours in old videos, it's much quicker to use a desktop video editor, especially with large files, as it will save you uploading and downloading.

OpenShot includes a range of tools



Tweak the colour in your old videos using a desktop program such as OpenShot

for improving the look of off-colour home movies, which you can access on its Effects tab. Drag an effect to the title of a video on the timeline and a letter representing it will appear next to the name. Right-click this and choose Properties to fine-tune the effect, either by dragging the sliders or by entering numeric values.

Options include 'Brightness & Contrast', Hue and Colour Saturation (see screenshot below left), and you can switch between them using the Selection dropdown menu. Revert a video to its original state by right-clicking the effect's letter and choosing Remove Effect.

Improve the audio quality of old videos

Old videos often suffer from background noise that makes it difficult

CONVERT OLD VIDEOS FROM OBSOLETE FORMATS

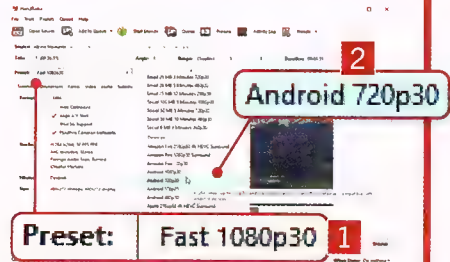
Before everyone started recording videos on their smartphones, many of us used digital camcorders. Unfortunately, some of the video formats used by these devices are now obsolete, which means you can't open them in many video editors.

Thankfully, help is at hand from the versatile free program HandBrake (handbrake.fr), which can convert virtually any old video, including movies captured by camcorders and ripped from non-copyrighted DVDs and Blu-rays, to the popular modern formats MP4 and MKV.

Click 'File' on the Source Selection screen (click Open Source if you don't

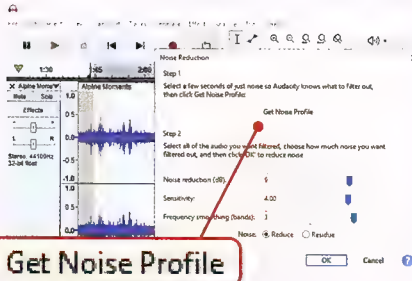
see this) to select a video and HandBrake will show you preview images of the contents. Click the Preset menu (1 in our screenshot) to choose a format and quality to convert to – if you're confused by all the options, choose the type of device you plan to watch the video on, such as Android (2) or Apple, or what you plan to do with it, such as Email or Social. Hover your cursor over an option for a full description. Specify the folder to save the converted video to and click Start Encode.

Alternatively, you can use the free online tool CloudConvert (cloudconvert.com/) to convert old videos into modern formats. Select a video, choose the



format to convert to – options include AVI, FLV, MKV, MOV and MP4 – and click the spanner button to specify the resolution and other options. Click 'Convert' to upload and convert the file, then play the processed video in your browser before you click Download.

RESTORE YOUR OLD PHOTOS & VIDEOS



Audacity can reduce background noise in the soundtrack of your old videos.

to hear what people are saying or produces a humming or buzzing sound. Many paid-for video-editing programs include an option for reducing this noise, but the best way to do it for free is to use the popular audio editor Audacity (www.audacityteam.org). You'll first need to install the FFmpeg Library plug-in, which allows Audacity to open video files – download it from lame.buanzo.org/ffmpeg.php and double-click the EXE file to install it. Launch Audacity and choose File then Open, and select your video to import its audio track.

When Audacity opens the file, you should be able to tell from the waveform where the noisiest parts occur, or you can click Play to listen to the audio. Select one of the sections with background noise then click the Effect menu and choose 'Noise Removal & Repair', then Noise Reduction. Click the Get Noise Profile button (see screenshot above) so Audacity can sample the unwanted portion of sound, then click OK. Now press Ctrl-A to select the whole track, choose the Noise Reduction effect again and either use the sliders to adjust the level of reduction, sensitivity and frequency, or stick with the default settings. Click 'OK' to apply the noise reduction, then save the edited audio track by clicking the File menu and choosing Export then 'Export as MP3' or 'Export as WAV'.

Next, open your original video in a video editor such as OpenShot, add it to the timeline and separate the existing audio track – in OpenShot, right-click the video and choose Separate Audio then Single Channel. Right-click the separated audio track and choose Remove (or Delete). Import your noise-reduced audio track into the program and drag it to the timeline aligned with the video track. When you play – and save – the video, it will now feature your improved soundtrack.

If that sounds like a lot of work, you can try a quick fix from Aspose's Remove Background Noise tool (www.snipca.com/44902). This free online service doesn't give you as much

DeepStory — Make your family photos speak

Upload a photo of an ancestor and automatically convert it to an amazing video biography.

[Upload photo](#)

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ANIMATE OLD FAMILY PHOTOS USING AI

Genealogy service MyHeritage offers several clever tools for bringing photos of your ancestors to life. Our favourite is Deep Nostalgia (www.snipca.com/44911), which uses AI to animate still images of family members and make their faces move realistically. Click 'Upload photo' to select a picture, then register for a free MyHeritage account. Your photo will be animated in your browser and you can download the amazing result as an MP4 video. To create more than five animations, you need to pay for a monthly subscription.

Also worth trying is MyHeritage DeepStory (www.myheritage.com/deepstory), which uses AI to add audio to your photos so your ancestors can tell their stories by speaking biographical information you provide, complete with matching mouth movements. Again, you can create and download up to five animations for free.

MyHeritage's latest AI addition is AI Time Machine (www.myheritage.com/ai-time-machine), which invites you to upload between 10 and 25 photos of yourself or a family member, to generate historically themed avatars such as Vikings and top-hatted Victorians. It's fun but not as impressive as the AI animations.

control over noise reduction as Audacity, but it did dampen background distractions in the videos we tested. Just upload your file or enter the URL of an online video and select a video format to save it in. Click Process and wait for the site to enhance the video and give you a download link.

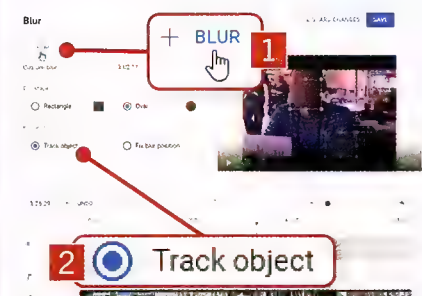
Blur faces and sensitive details

If you want to share an old video online without compromising the privacy of individuals who appear in it, consider blurring their faces. YouTube offers a free tool for this purpose, which identifies faces in videos and lets you blur people who might not want to be recognised, without affecting the rest of the content.

To use the option, open the YouTube Creator Studio (<https://studio.youtube.com>), click Content and select a video you've uploaded. Click 'Editor' then choose Blur (1 in our screenshot above right) and click 'Face blur'. YouTube will detect all the faces that appear in the video and let you choose which people to blur – click Apply then Save to confirm.

You can also choose 'Custom blur' to disguise a specific item in a video, such as a car registration plate, house number or something embarrassing. Find the element you want to blur in the video, select a blur shape and specify the blur behaviour – choose 'Track object' (2) to keep the item blurred wherever it or the camera moves. Repeat this for as many elements as you want to blur.

Even if you don't make the processed video publicly available on YouTube, you can still download the result with all the blurs intact. ■



YouTube lets you blur people and objects in old videos before you share them.

QUICK TIPS

The problem solvers

The APC team field problems across the spectrum of devices and software.

Learn a new trick or fix you can use.

TPM chip needed?

I have two i7 computers that fail the Microsoft Windows 11 requirements test: the problem is TPM and Secure Boot. I am starting to look at motherboards for an i9 build next year. From what I've seen so far, none come with TPM, but all say they are capable of running Windows 11.

Are we in a situation of having to buy a TPM card if we want Windows 11? Why aren't manufacturers including TPM? Is it safe to assume all recent motherboards include Secure Boot?

John Reilly

APC responds: If your processor meets the minimum requirements for Windows 11, then there's no need to buy a TPM card for your motherboard, John. Modern Intel and AMD CPUs – specifically those built after 2014 – come with TPM embedded into their firmware; however, only later CPUs, from around 2017, support TPM 2.0, which is the minimum requirement for Windows 11. You can view a definitive list of CPUs supported by Windows 11 at (<https://learn.microsoft.com/en-us/windows-hardware/design/minimum/supported/windows-11-supported-intel-processors>) – all of these will work without the need to worry about TPM support on the motherboard.

As you're building a new PC, make sure you choose a CPU from this list – any i9 CPU from 2017 onwards (so i9-7900X series and up) is supported. As for Secure Boot, all recent motherboards support it – including those that are Windows 11 compatible.

Audiophile PC build

I am a long-time subscriber, and this is a follow-up question I had earlier this year ("One for audio files...").

The main issue with building a media computer is getting high-resolution, audiophile-quality sound from a PC. My receiver (Pioneer Elite SC-68) has a reasonable quality asynchronous USB DAC input port, so I don't need a separate external DAC unless I wanted to use a high-end DAC. Either way, the audio connection

from the computer to the DAC (external or the one in the SC-68) would be through a USB connection.

However, the audio from a computer is not as good quality as it needs to be. It's my understanding that most motherboards (or sound or video cards) do not provide high-end audio, which is why media computers such as the ones from Baetis use their own daughter card just for the audio. They also have boards to improve on other things such as the USB.

What would you recommend for a high-end audio computer build that can come reasonably close to something like a Baetis media computer?

John

APC responds: You're probably already better versed than APC in these matters, John – his idea of top-quality audio is streaming FLAC music over Wi-Fi to a Raspberry Pi Zero sporting a now-discontinued 24-bit/192kHz Pi-DACZero connected to his 30-year-old Pioneer stereo. It sounds great to him, but in the absence of such expert knowledge, he will instead draw on his research skills to hopefully steer you in a useful direction.

First, a quick read of Baetis's many white papers reveals its top-end PCs avoid using the PCI bus for both its daughter cards and USB ports to minimise signal noise. As your DAC is capable of playing most audio formats directly from your PC, you could technically retrofit an existing PC with audiophile-friendly USB ports to deliver the music straight to your DAC. When it comes to USB, Baetis uses SOTM (<https://sotm-audio.com>) ports, which you could replicate by investing US\$350 into its tx-USBhubIN card. This connects directly to an internal USB header on your motherboard to bypass the PCI bus.

Dig a little deeper into the SOTM website, however, and you'll discover the company goes one step further, offering full-blown Intel motherboards optimised for audiophile use. Prices start from US\$550 for the SMB-Q370, which you would then augment with the

tx-USBhubIN card and an optional Ethernet card if you decided to go down the server route (this would enable you to offload your music to a PC dedicated to the task).

Another key issue is 'noise' from your computer through its fans and PSU. Audiophiles recommend BeQuiet's range of quiet CPU fans – the Dark Rock 4 (www.bequiet.com/en/cpucooler/1376) can be had for around 1095 online – as well as the HDPLEX Linear Power Supply range (<https://hdplex.com>), which cost significantly more and are recommended by Baetis itself as an upgrade to its own PSUs. By now, you can see that the costs of building your own audiophile PC to rival the Baetis are starting to mount.

Generally speaking, APC would suggest you comb through the Baetis white papers with a fine tooth comb, making a note of any references to manufacturers like SOTM. Then, visit the manufacturer directly to see what's available before Googling the model name and 'review' to see what others make of it. This in turn will reveal useful resources like Audiophile Style (<https://audiophilestyle.com/>), which carries a review of the SMB-Q370 motherboard and offers forums where you can converse with like-minded enthusiasts who will be able to offer you more nuanced expert advice.

Split apps from Windows?

I've been a subscriber for ages and love your magazine. A few years ago, I followed your instructions for setting up the operating system on one drive, programs on a different drive, and data on yet another drive, possibly using partitions. I can't find the issue with those instructions, but it was one of the best-running systems I've ever owned.

I have searched for guides on installing Windows 11 in a setup where programs and data are automatically stored on different drives, with drive C maintained solely for Windows. Is that a good idea and, if so, can you tell me how to install Windows that way?

Robert Kent

APC responds: APC has long been an advocate of separating data from Windows and your apps, that way, if your Windows installation corrupts, your data remains easily accessible. But he's never been a fan of separating Windows from installed programs. The simple reason is that programs are so tied into Windows that if your Windows installation goes down so, too, will your programs, regardless of where you store them.

APC recommends storing portable apps on a separate drive – again, like your data, they aren't tied into your Windows installation and can be reused with no problems in a brand-new install. But as far as installed programs go, unless you're running Windows from a small boot drive and are running out of space, there's no reason to split them off.

If you find yourself running out of space, consider a program such as SteamMover (www.traynier.com/software/steammover) to move apps to another drive.

Finally, whether you split data and Windows/apps on the same drive through partitioning or store them on separate physical drives, neither option is an excuse not to keep an additional backup of both in a secure location such as a NAS or encrypted cloud storage.

What, no 16-bit support?

Long-time reader, first-time writer. I just bought a new Dell desktop and it came with Windows 11 as an OS. Boy, has it been a struggle going from Windows 7! One of my main problems is that I cannot even install my legacy 16-bit programs. My studies indicate that it was possible in Win 10, but never in the latest version of 11. I certainly won't be renting Microsoft Office or paying an enormous price for Adobe Photoshop. There must be a way around this that doesn't preferably involve sandboxes.

Frank Tushoph

APC responds: The reason you can't run 16-bit apps in Windows 11 is that it's now a 64-bit-only OS. The workaround in Windows 10 – enabling NTVDM support under Legacy in the Windows Features control panel – only worked with 32-bit versions of the operating system. There's no way to get your old apps running directly in Windows 11.

That said, if you're still relying on



Reducing signal noise is vital for sound quality.

16-bit apps then APC suggests that rather than investigate workarounds like DosBox (www.dosbox.com) or VirtualBox (www.virtualbox.org), you simply replace your old apps with new, open-source, or freeware alternatives. LibreOffice (www.libreoffice.org) is the obvious replacement for Microsoft Office, while Paint.NET (<https://getpaint.net/>) is a good substitute for Photoshop, and if Paint.NET is missing features you subsequently need, try GIMP (www.gimp.org) instead. Search for other alternatives to old programs using the AlternativeTo (<https://alternativeto.net/>) website.

No life from new build

I am desperate here! I've built a computer from these components and checked at (pcpartpicker.com): Gigabyte Z690 motherboard, Intel Core i5-12600K desktop CPU, 2x 32GB Corsair Vengeance LPX RAM, 2x WD Blue SN570 NVMe drives (1TB and 2TB), Corsair RMX Series (2021), RM1000x, 1000W PSU, and Noctua NH-U9S chromax.Black, 92mm Single-Tower CPU, housed in a SilverStone Technology CS380 8-Bay Compact ATX Tower case, CS380B-X V2.0, Black.

When I plugged it in and turned it

on nothing happened! I double-checked the I/O connections. Could it be the connections from the case to the motherboard? I am at a total loss as I have never had a build that did not at least power up at all. Can you help me troubleshoot?

Lee Gilman

APC responds: We ran Lee through all the usual

"What would you recommend for a high-end audio computer build that can come reasonably close to something like a Baetis media computer?"

troubleshooting steps, including stripping the PC back to the essential parts to make it boot, but when we asked him to check the connections a second time, he came back with a question that fixed the problem.

After connecting the 24-pin ATX and 8-pin ATX 12V 2x4

power sockets on the motherboard to the Corsair PSU, Lee found that there was no connector for the ATX 12V 2x2 power, so he made use of a 6-pin PCI-E plug from Corsair, leaving two pins hanging.

The ATX 12V 2x2 connector is optional, and only required for extra-heavy loads – you shouldn't connect the 6-pin PCI-E plug to it. Thankfully, given the horror stories online about fried CPUs, Lee disconnected the connector and his new build booted first time. ■

WINDOWS

Wipe junk files using a USB stick

PCs get messy as they age.

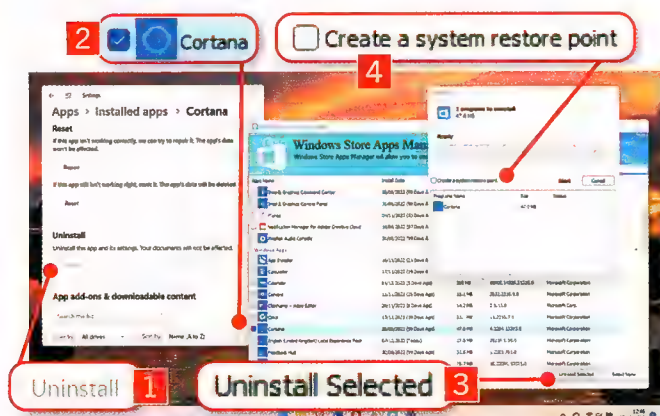
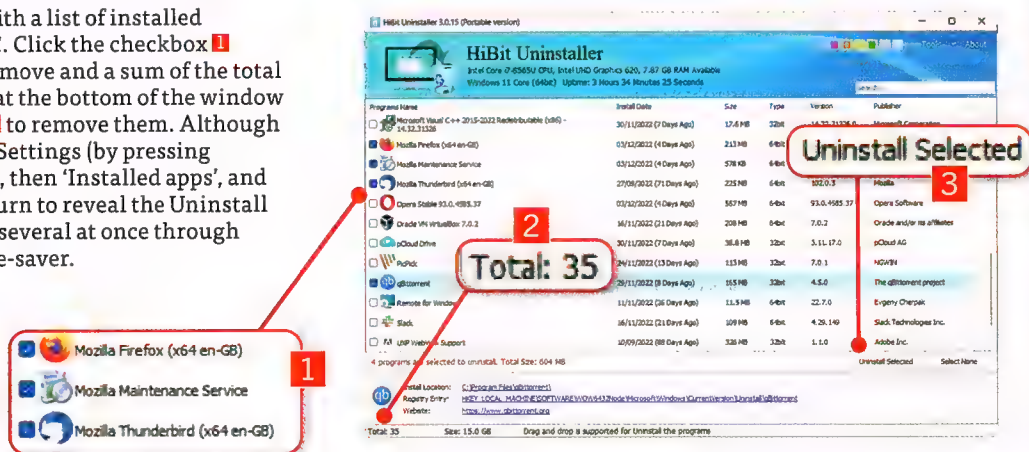
Deleted software leaves junk behind, some programs are installed without your knowledge, folders get emptied and left to stagnate, and personal data isn't properly wiped. The recently updated HiBit Uninstaller addresses each of

these issues, and more, by gathering a long list of powerful file-deletion tools in an interface that's easy to use. You can download a free copy from www.hibitsoft.ir/Uninstaller.html, where there's a choice of installable or portable versions. As the portable

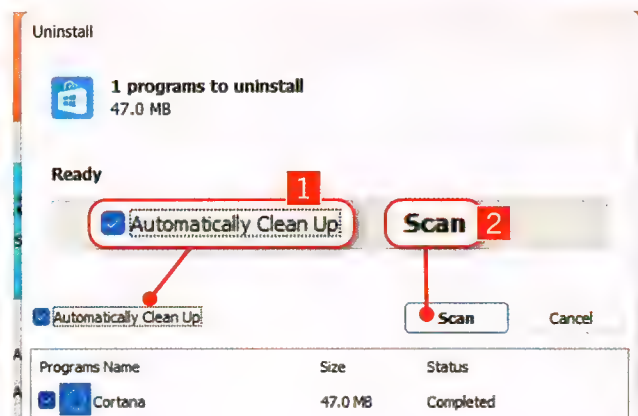
version can be run from a USB stick, you can easily move it between PCs. Because it doesn't need to be installed, it won't contribute to the existing clutter on our drive.

"The recently updated HiBit Uninstaller addresses each of these issues, and more, by gathering a long list of powerful file-deletion tools in an interface that's easy to use."

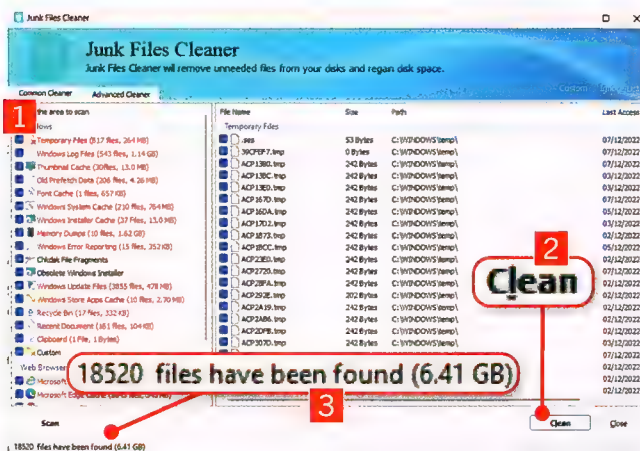
01 HiBit Uninstaller opens with a list of installed programs detected on your PC. Click the checkbox **1** beside any that you want to remove and a sum of the total space you'll recover is shown at the bottom of the window **2**. Click 'Uninstall Selected' **3** to remove them. Although you can do the same through Settings (by pressing Windows key-I, clicking Apps, then 'Installed apps', and clicking on each program in turn to reveal the Uninstall button), the option to remove several at once through HiBit Uninstaller is a real time-saver.



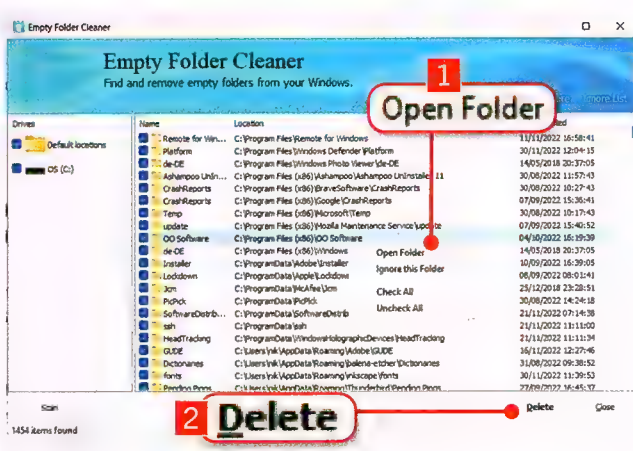
02 HiBit Uninstaller can also remove programs that Settings can't. As you can see, the Uninstall button for removing Cortana is greyed out **1** in Settings on our PC, but it can still be selected in HiBit Uninstaller **2**. To reach this option, click Tools and select Windows Store Apps Manager, then scrolled down to the Windows Apps section. Click 'Uninstall Selected' **3**, then tick the box beside 'Create a system restore point' **4** and click Start. This saves a copy of your PC's current configuration to which you can return if anything goes wrong.



03 Having created your system restore point, HiBit Uninstaller removes Cortana, which will also be removed from the list of installed programs in Settings. Tick the box beside 'Automatically clean up' **1**, then click the Scan button **2** and HiBit Uninstaller will search your PC for any remnants, which it will also remove, before returning you to the list of installed software. If you're removing software because you're running short of space, re-order the list by clicking the Size column header so the largest programs appear at the top.

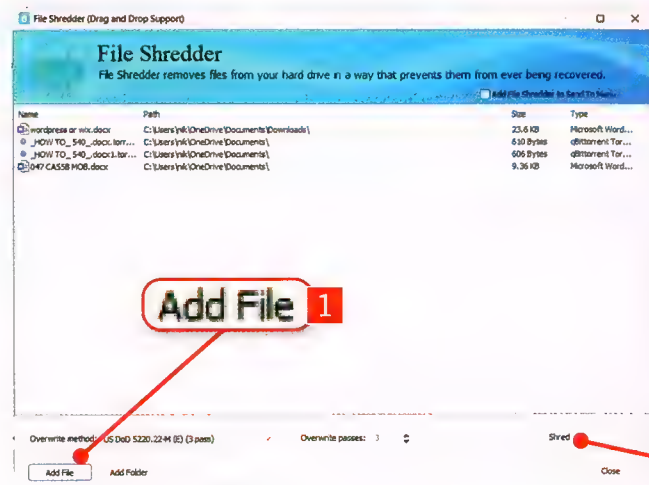
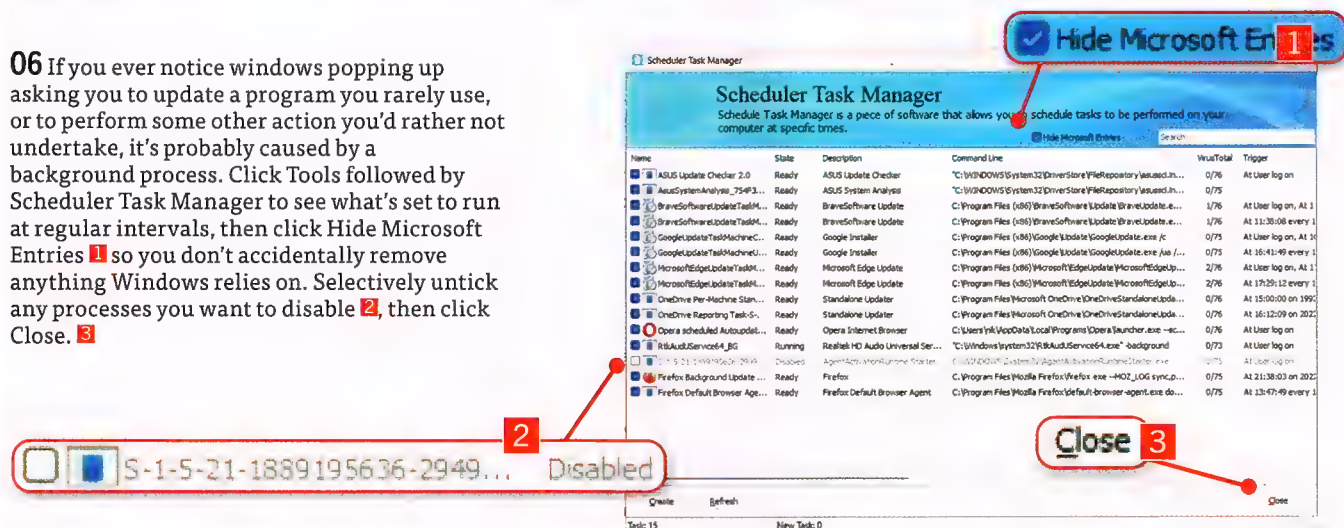


04 HiBit Uninstaller doesn't only remove software: it can also find and delete junk that's needlessly taking up space on your drive. Click Tools, followed by Junk Files Cleaner, then in the left pane tick each of the categories of junk you want to scan for **1**. When it shows you what it's going to remove, untick any you want to keep in the right pane, then click Clean **2**. As you can see from the grab, if we removed everything it's found here we'd be able to reclaim almost 6.5GB of otherwise wasted disk space **3**.

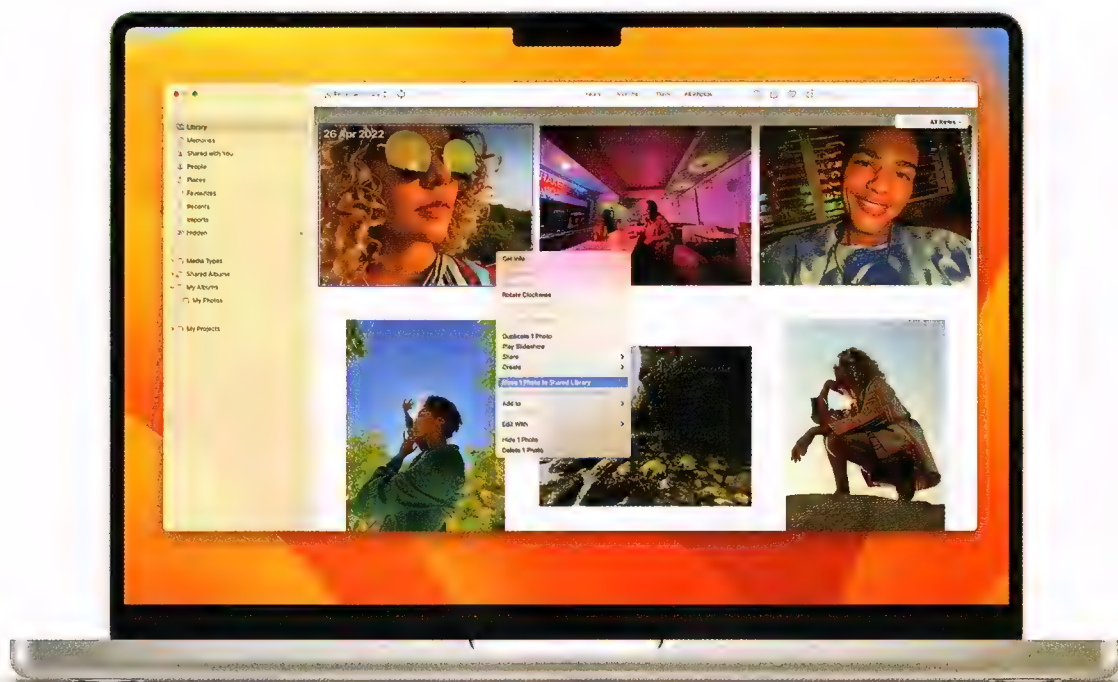


05 Sometimes, you want to remove items from your drive not so much because they're taking up space, but because they're untidy and confusing. Empty directories, left over from old software, are a case in point, and they can be scattered across your drive. So, to round them up and delete them, click Tools and select Empty Folder Cleaner. If you want to check that a folder really is empty before removing it, right-click it and select Open Folder **1**. To wipe away the selected folders, click Delete **2**.

06 If you ever notice windows popping up asking you to update a program you rarely use, or to perform some other action you'd rather not undertake, it's probably caused by a background process. Click Tools followed by Scheduler Task Manager to see what's set to run at regular intervals, then click Hide Microsoft Entries **1** so you don't accidentally remove anything Windows relies on. Selectively untick any processes you want to disable **2**, then click Close. **3**



07 Finally, as you probably know, when you delete a file it's not removed from your disk – just from the index of files Windows keeps track of, which means hackers could still recover it. To delete it permanently, click Tools and select File Shredder, then click Add File **1** and navigate to the file you want to remove. Repeat for any other files you want to delete at the same time, then click Shred **2**. The files will be overwritten rather than being sent to the recycle bin, so make sure you really do want to destroy the selected data before following this step. ■



MAC OS

Easily share your photos

Sharing photos with friends is easy with iCloud Shared Photo Library.

IT WILL TAKE
20 minutes

YOU WILL LEARN
How to create a Shared Photo Library for friends and family

YOU'LL NEED
Photos app, macOS 13, iOS 16, iPadOS 16 or later

 You've long been able to share photos in the Photos app – although this was limited to photos you specifically chose to add to a special shared album, that then got posted to iCloud. While that was useful, shared albums only worked one way – so while you could post photos taken at a shared event (a gig you all went to, or a family gathering, say) none of your

friends or family could add pictures they'd taken. iCloud Shared Photo Library changes all that.

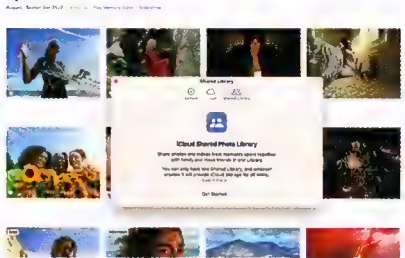
Available now as part of macOS Ventura, iOS 16.1 or iPadOS 16.1, iCloud Shared Photo Library not only enables you to share photos and videos easily with friends and family, but also enables them to add to, edit and amend the contents too, making

the whole process of sharing much more collaborative. You can even set Photos to upload any new photos or videos you shoot automatically, although you can also retain full manual control if you wish. Here we'll explore how to set up an use iCloud Shared Photo Library.

Rob Mead-Green

HOW TO CREATE A SHARED PHOTO LIBRARY

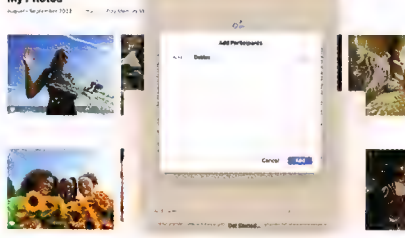
My Photos



1 LET'S GET STARTED

To create a shared photo library, open the Photos app on your Mac, then select Photos > Settings from the menu bar. In the window that appears, select the Shared Library tab, then click the Get Started button.

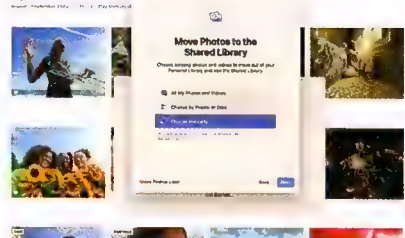
My Photos



2 ADD FRIENDS AND FAMILY

Next, add the people you want to share your photo library with. In the Add Participants screen, click the '+' button then type in the names of the people you want to add. They'll need to be using macOS 13, iOS 16.1 or iPadOS 16.1.

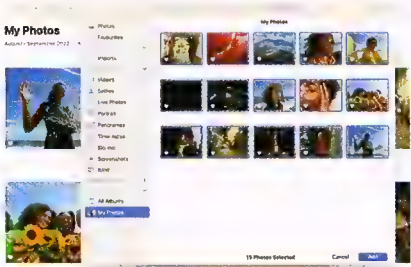
My Photos



3 SHARING OPTIONS

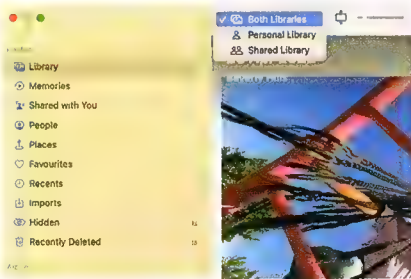
Now it's time to decide what you want to share. In 'Move Photos to the Shared Library', select one of three options: 'All My Photos and Videos', 'Choose by People or Date', or Choose Manually. Let's choose manually.

CONTINUED... CREATE A SHARED PHOTO LIBRARY



4 SHARED LIBRARY PREVIEW

You'll now be able to decide which of the photos and videos in your library you want to share. Once you've finished making your selections click Add. You'll then see a preview of the Shared Library containing the images you selected.



7 VIEWING LIBRARIES

Unlike in Photos albums where an album's contents can be both in a Library and in an album, your images and videos can only exist in one Library at a time. However, you can view the contents of both libraries at the same time.

Camera Shared Library

Share from Camera

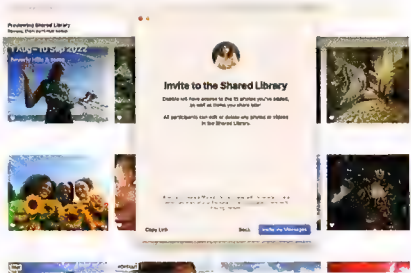
Share photos and videos to the Shared Library from Camera.

Share Automatically

Share Manually

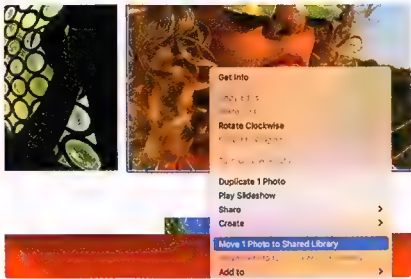
10 CAMERA SHARING

iCloud Shared Photo Library works exactly the same way on iPhone and iPad, except you can choose to automatically share any photos you take with the Camera app either via Bluetooth or directly to your Shared Library.



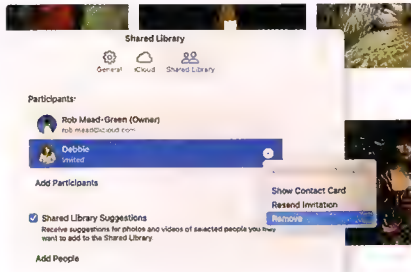
5 SEND OUT INVITATIONS

With your Shared Library prepared, you can now ask the friends and family you added to the Participants list earlier to join you – either by sending them an iMessage or by clicking Copy Link to grab a weblink that you can send via Mail.



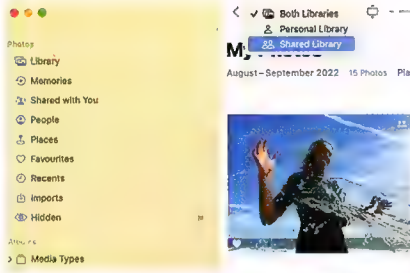
8 MOVING IMAGES

To move an image you want to share from your Personal Library to your Shared Library, simply Ctrl-click its thumbnail and select 'Move [x] Photo(s) to Shared Library' or select Image > 'Move...' from the menu bar.



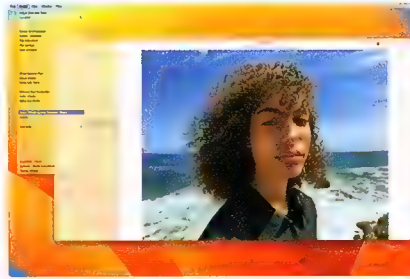
11 REMOVE PARTICIPANTS

If one of your friends or family decide they no longer want to be part of the Shared Library, you can remove them from the Participants list. To do that, click the '...' to the right of their name, then select Remove from the drop-down.



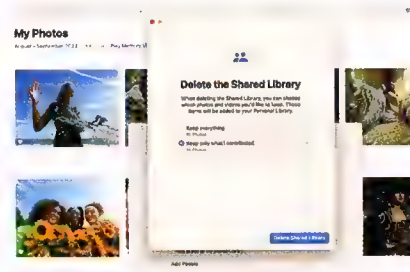
6 SWITCHING LIBRARIES

In Photos' main window, you'll now see a menu that enables you to switch between your existing Personal Library, the Shared Library you created, or the contents of Both Libraries. You can only have one Shared Library at a time.



9 SHARED IMAGE WARNING

Any images you move to your Shared Library and easily be edited or even deleted by other members of your Participants list. To stop that happening to a particular image, either move it to your Personal Library or make a copy.



12 REMOVE SHARED LIBRARY

You can also choose to delete the Shared Library altogether. To do that, go to Photos > Settings > Shared Library > Delete Shared Library. You'll be given the option to move any shared images and videos to your Personal Library.

LINUX

Super system monitor

No sniggering at the back as Shashank Sharma shows you his bottom.



QUICK TIP!

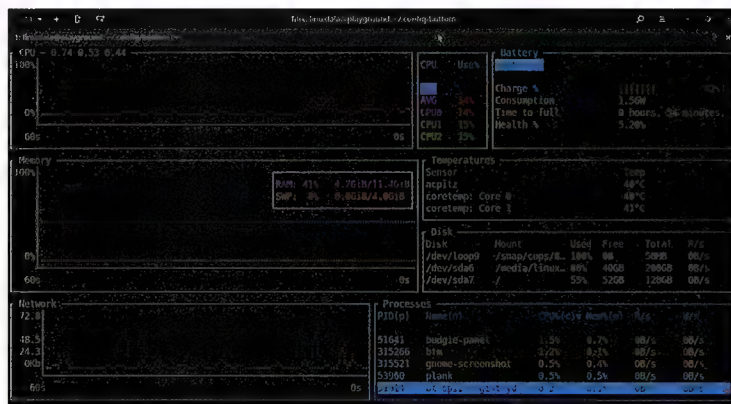
While we prefer the full-featured default interface, you can optionally launch Bottom with the `btm -b` or `btm --basic` commands. This launches Bottom with a basic interface that doesn't feature any graphs. You'll also have to scroll to the left or right to access the different widgets, such as Disks.



System monitors come in all shapes and sizes. At a minimum, they provide a quick look at active processes and CPU and memory utilisation. Some tools, however, go a step further and also provide information about disk and network I/O. More often than not, the system monitor also provides colourful graphs and even lets you sort or kill processes. If you think all this is only possible with graphical utilities, you're in for a surprise.

Written in Rust and released under the MIT licence, Bottom is a rather robust system monitor with all the features listed above, and more. You won't find it in the software repositories of most distros, the exception being Arch Linux, but the project publishes a Deb binary for Ubuntu, Debian and other derivative distros, in addition to precompiled binaries. You'll find installation instructions on the project's GitHub page for different distros such as Fedora, where Bottom can be installed using the Copr repository.

As Bottom is written in Rust, one distro-neutral option to install it is to use Cargo, the package manager for Rust utilities. If you don't already have Rust and Cargo, you can use your distro's package manager to install these – `sudo`



You must launch Bottom with the `btm --battery` command if you wish to enable the Battery widget.

`dnf install rust cargo` installs these on RPM-based distributions such as Fedora. You can similarly run `sudo apt install cargo` which also installs the Rustc package, if you're running Ubuntu or Debian or one of their derivatives.

With Cargo installed, you can now run `cargo install bottom` to install Bottom. You can launch it with the `btm` command. The interface features a number of different panes, such as CPU, Memory, Processes and so on. Bottom refers to these as widgets. The default interface features six different widgets.

Bottom's up

The CPU widget shows a graph depicting the CPU usage. Immediately to the left of the graph you'll find a list of all the

CPUs, if you're on a multicore machine, along with the percentage use for each, as well as an average. You can select individual cores, or click All or Average, and Bottom shows the corresponding graph, depending on your choice.

The Memory widget similarly displays the memory usage, as well as the current RAM and swap usage percentages. The Temperature widget reads the relevant sensors and defaults to Celsius. You can run Bottom with the `btm -f` command if you'd rather have the temperature displayed in Fahrenheit.

Next is the Disk widget, which lists all the devices along with relevant information such as mount point, used space in percentage, free space, as well as read/write speeds. You have

CONFIGURING BOTTOM

If you dislike the default colour options, Bottom features several different themes for you to choose from. You can switch from the default theme with the `btm --colour <theme>` command. Your choices are default-light, gruvbox, gruvbox-light, nord and nord-light.

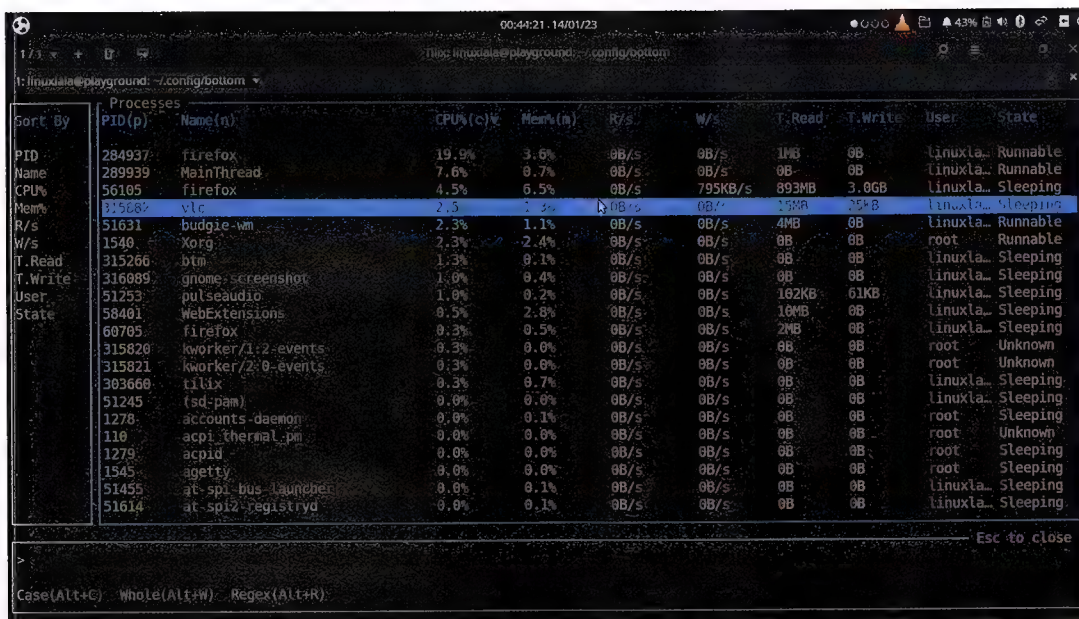
In addition to the different command options and keybindings, you can also control Bottom's behaviour by tweaking its config file. If you installed Bottom using Cargo, you can find the `bottom.toml`

config file in the `~/config/bottom` directory.

This default config file is entirely commented out, leaving you free to enable all the settings you wish to use with Bottom. It is another good place to start to make sense of the different command flags available for use. For instance, you can set `battery = true` in the config file if you wish to enable the Battery widget by default but don't wish to launch Bottom with the `btm --battery`

command. You can similarly define the colour scheme you wish to use in the `bottom.toml` config file. Additionally, you can use custom colours for the different headers such as CPU, Memory and so on, as well as the colours for the CPU, memory and network graphs.

Once you've tailored the config file to your liking, you must run Bottom with the `btm -C <path-to-config-file>` command so it adopts your defined parameters instead of the defaults.



You'll notice the Sort widget on the left and the Search widget at the bottom in this expanded view of the Processes widget.

to expand the Disk widget to fully appreciate all the information on offer. This is because Bottom limits the amount of information on display depending on the size of the emulator window.

This is why, for optimum results, you should consider expanding the size of the terminal emulator window, or ideally maximise the window to full screen.

The Network widget shows the received (Rx) and transmitted (Tx) network traffic as a graph as well as in percent usage. Finally, the Process widget lists the currently running processes.

Although not enabled by default, Bottom can also show the status of the battery. The Battery widget displays the charge percent, time to battery empty/full charge and battery health.

Unlike other similar tools such as Glances (a system monitor written in Python), it's possible to select individual widgets and expand them to occupy the full screen. For instance, click the Processes widget at the bottom-right of the interface. You can identify the selected widget as the colour of the boundary changes. Now press **e** and you'll notice that the Processes widget expands to full-screen mode. You can return to the main interface by pressing **e** again or hitting Escape. You can also navigate the different widgets by pressing Shift + arrow keys.

The CPU, memory and network graphs refresh every 60 seconds by default. You can use the mouse scroll wheel or the + and - keys to change this.

Process management

You can tweak Bottom's appearance using different command flags. For instance, you can run Bottom with **-f**, **-c**, or **-k** to display temperature in Fahrenheit, Celsius or Kelvin respectively. The **--battery** flag can be used to enable the Battery widget. If you dislike the default graph style, you can run Bottom with the **btm -m** command to switch to a dot marker for graphs. Run the **btm -h** command for a complete list of all available flags and a brief description, or the **btm --help** command for more details.

Bottom also supports a number of keybindings for some of the widgets, such as Processes:

KEYBINDING	FUNCTION
dd	Kill the selected process
t	Toggle tree view
Tab	Toggle grouping processes with same name
s	Open the sort widget
c	Sort processes by CPU usage; press again to reverse order
m	Sort processes by memory usage; press again to reverse order
n	Sort processes by name; press again to reverse order
l	Invert current sort
M	View metadata information

To test these keybindings, first select the Processes widget from the main interface and expand into it by pressing **e**. You can sort the processes based on CPU or memory usage, as well as read/write

operations and so on, either using the Sort widget or directly using the different keybindings as listed in the table.

You can also kill a process with Bottom by first selecting it from the list in the Processes widget and then pressing **dd**.

It's also possible to search for processes by pressing **/**, which opens the Search widget.

Bottom filters results as you start typing. The Search widget defaults to case-sensitive search, as evident from the selected Case (Alt-C) entry at the bottom. Press Alt-C to perform a case-insensitive search. You can search using whole words with Alt-W.

In addition to searching for processes by name, such as **firefox** or **gedit**, you can also use Bottom to identify processes based on CPU or memory usage. For instance, type **cpu > 4** for a list of all processes that are taking up more than four percent of the CPU. The **cpu > 4 mem > 12** search string similarly returns processes that take up more than four percent CPU and 12 percent of the RAM.

You can exit the search by pressing Esc. Remember to delete your search string after you're done, otherwise Bottom limits the processes to matching results only, if any. That is, Bottom doesn't revert to the complete list of processes even when you exit the Search widget. You must manually delete your search string or pattern before exiting the Search widget.

For a complete list of supported keybindings available for the different widgets, press **?** from within Bottom to open the Help menu. ■

MOBILE DEVICES

Phone and Tablet Tips

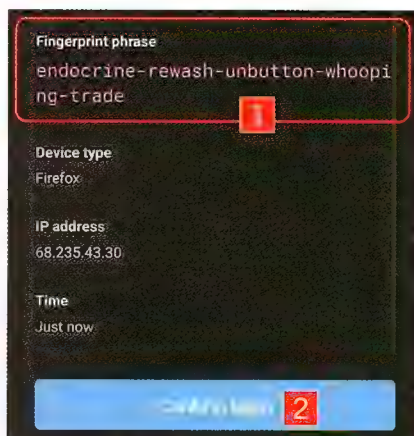
Brilliant things to do on your device.

ANDROID & iOS

Sign into Bitwarden without a password

The brilliant free password manager Bitwarden has updated its mobile apps with a passwordless authentication feature. This allows you to log into your web vault from your phone or tablet without needing to enter a password.

To use the new login method, install the Bitwarden app for Android (tinyurl.com/APC519BITWA) or iOS (tinyurl.com/APC519BITW), if you don't already



have it, and sign in with your master password. Tap 'Settings' in the bottom-right corner of the app, choose 'Approve login requests' and turn on the option by selecting Yes. In your desktop browser, visit your Bitwarden web vault (<https://vault.bitwarden.com>), enter your email address if prompted and click the new 'Log in with device' option.

This will send a notification to your phone or tablet that asks if you are trying to log in. Ensure that the 'fingerprint phrase' (1 in our screenshot below left) matches the one given in your browser, then tap 'Confirm login' (2). If it doesn't match, tap 'Deny login'. You'll now be signed into your web vault without entering your password.

To save you having to enter your master password in the Bitwarden app too, go back into Settings and switch on 'Unlock with Biometrics'. This lets you log into the app using your fingerprint or face, depending on which method you use to unlock your phone or tablet.

ANDROID & iOS

Play even more games with Netflix

Netflix is continuing to expand the selection of games in its

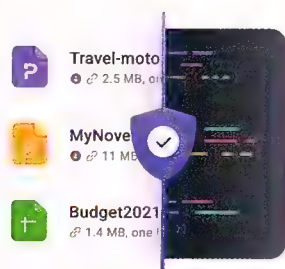


mobile app to give everyone something to play in-between watching TV shows and films. The latest additions include the classic card game *Solitaire*; *Scriptic: Crime Stories*, in which you gather clues to catch a criminal; and military strategy game *Reigns: Three Kingdoms*.

Netflix now has more than 40 games, which are all free to subscribers and have no ads or in-app purchases. To access them, swipe down to the Mobile Games section on the app's home screen, select a game and tap 'Get game' (see screenshot left) to install it from the Google Play or Apple App Store.

BEST NEW APPS

What you should install this month

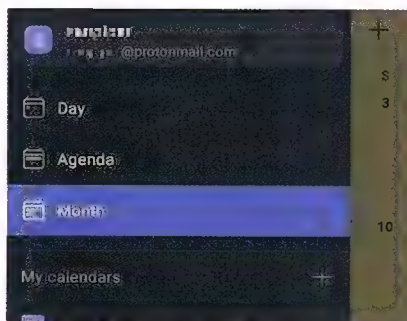


PROTON DRIVE

Free* | Android tinyurl.com/APC519PD

iOS tinyurl.com/APC519PDI

Privacy-focused company Proton has launched mobile apps for its online storage service, Drive. Upload files and folders from your phone or tablet, access items offline and create secure links to share with other people, with all data encrypted on your device. You get 500MB of storage for free.



PROTON CALENDAR

Free* | Android tinyurl.com/APC519PC

iOS tinyurl.com/APC519PCI

Now available on iOS (the Android app was released last April), Proton Calendar lets you create a private schedule that - unlike Google Calendar - is free of ads, trackers and data sharing. Your calendar is end-to-end encrypted and you can switch between a daily or monthly agenda, and light or dark mode.



PUMA

Free | Android tinyurl.com/APC519PU

iOS tinyurl.com/APC519PUI

Sportswear brand Puma has updated its app with an innovative feature called Virtual Try On. This uses augmented reality to show you how different styles of trainers will look on you. Select one of 23 styles, tap the AR button, then point your phone's camera at your feet to try the trainers on and walk around.

iOS Use SwiftKey on your iPhone or iPad again

Apple Last October, Microsoft removed its popular keyboard app, SwiftKey, from the Apple App Store without giving a reason. This led many iPhone and iPad users to seek an alternative keyboard tool, while calling on Microsoft to restore and update SwiftKey. The company has now complied with both those demands and a new version of the app is available to install from tinyurl.com/APC519SKEY – the first update it's received since August 2021, when it introduced emoji search.

Don't get too excited, however, because SwiftKey 2.9.4 for iOS merely applies "bug fixes and performance improvements", including fixing a problem that stopped users logging into their Microsoft accounts. It also still lacks several features found in the Android version. But at least SwiftKey is available for iPhone and iPad again, and hopefully future updates will be more frequent and significant.

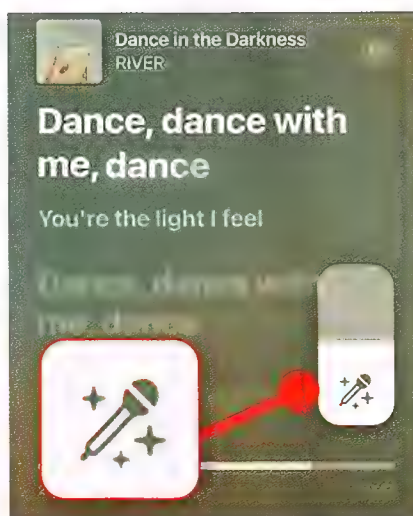
ANDROID Make online content easier to read and hear

Google has launched a new app called 'Reading mode' (tinyurl.com/APC519RD) to help people with poor vision and dyslexia read online content more easily. Install the app from the Google Play Store, then open Settings on your Android phone or tablet, select Accessibility and tap 'Reading mode'. Switch on 'Reading mode shortcut' and tap Allow to give the app control of your device.

11 Google Drive tips to save you time

Anyone who has ever had their computer crash midway through writing something important will be grateful for Google Drive, one of the best cloud storage options there — but that's not all. Here are 11 tips to help you get the most out of Google Drive. 1. For. 2. Google Drive is the go-to choice for many professional teams across industries.

*Contains in-app purchases



A floating shortcut will now appear on the side of your screen, which you can move around as required. Tap this shortcut when viewing an article in your mobile browser or another app to convert the content to a more accessible version. This removes everything but the text and enlarges it to make words easier to read. Tap the Settings cog in the bottom-left corner (1 in our screenshot below) to adjust the size, font and format of the text, and customise the theme.

'Reading mode' also lets you hear articles read aloud. Tap the play button, bottom centre (2), to start listening to content, then tap the other controls to pause, skip back and forth, and control the playback speed. You can change the app's reading voice by tapping Settings, then Audio and selecting an option in the dropdown menu.

iOS Sing along with songs on Apple Music

Apple has added a karaoke feature to its Apple Music app, so you can sing along with songs. Apple Music Sing provides scrolling 'real-time' lyrics for the current track – a feature already available in Spotify – which you switch on and off by tapping the new Lyrics button in the bottom navigation bar (this looks like a quote symbol in a chat bubble).

The clever part is you can control the song's vocal levels using a volume slider, and mute or fade the original artist to sing the lead part yourself – tap the microphone icon (see screenshot left) to activate this option. There's a 'duet view' that splits the screen to separate the lyrics for each singer, while the words for background vocals can also be shown independently.

Apple says the new feature will work with "tens of millions" of tracks, and it has also created 50 playlists of karaoke classics to get you started. Find out more at tinyurl.com/APC519MUS. ■

BEST APPS FOR...

Improving your sleep

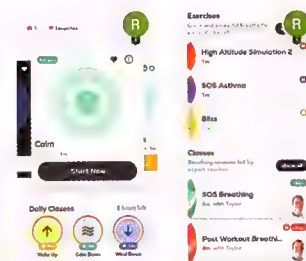


SLEEP CYCLE

Free* | Android tinyurl.com/APC519SL
iOS tinyurl.com/APC519SL

This app tracks your sleeping habits to determine whether you're getting enough quality kip. Sleep Cycle will wake you with a gentle alarm when you enter a light sleep phase in the morning and lets you track your sleep data over time. Upgrade to Premium to unlock extra features including sound recording.

Best for analysing your sleep habits

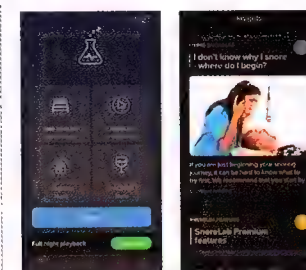


BREATHWRK

Free* | Android tinyurl.com/APC519BR
iOS tinyurl.com/APC519BR

Named one of Google's best apps of 2022, Breathwrk offers breathing exercises and daily classes to reduce anxiety, relax your muscles and help you sleep. Follow its instructions to inhale, exhale and hold your breath for different lengths of time. Try the lung tests, and tailor the app to suit your needs and lifestyle.

Best for mastering breathing techniques



SNORELAB

Free* | Android tinyurl.com/APC519SN
iOS tinyurl.com/APC519SN

Is your snoring keeping your other half awake, or is theirs disturbing you? SnoreLab can help by recording overnight snoring so you can analyse it in the morning, try suggested remedies and track your (or the snorer's) progress. After a seven-day free trial, you need to pay \$5.99 per month to use all the app's features.

Best for recording and tracking snoring

Add and monitor control sensors

Making sense of the situation, Les Pounder shows us how to use sensors with a robot to get about town!

YOU'LL NEED THIS

- The robot build from part two
 - HC-SR04 P or HC-SR04 and ultrasonic sensor
- Obstacle/PIR sensor
 - Arcade button
- A strip of M-to-F jumper wires
 - A breadboard
- Code: <https://tinyurl.com/APC519ROBOT3>

PART 3

Don't miss next issue, subscribe on page 20!



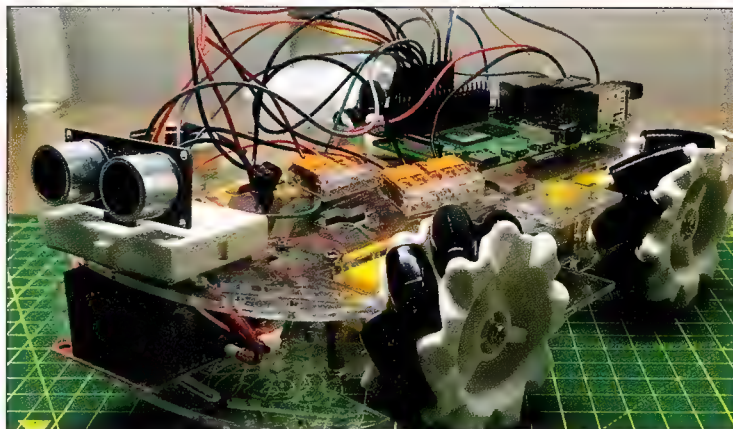
At the end of part two, we had successfully built our robot from a kit, soldered the motors and tested them using a series of directional commands. To facilitate this, we created our own Python module to make things easier to control and abstract away some of the complexities. In this part, we move on to writing code that takes data from sensors and uses it to give our robot 'brains'.

Sensors, much like our own, provide a means to see and interact with the world around us. We use our eyes to see the world. Robots can see the world around them with OpenCV (Open Computer Vision), which uses machine learning to identify objects and people, and react accordingly. At a more basic level, robots can 'see' using ultrasonic and obstacle sensors. There are so many sensors to choose from it can bewilder even the most seasoned of makers. We've chosen to stick with the most basic forms: infrared, buttons and ultrasonic sensors. The more advanced methods of input and control will come in a future part.

This part can become quite complex – remember, we are working with multiple types of sensors. We will write the code and test each one as we go. We may use them all, or just a few. That is a decision for you. Make your robot as complex or simple as you wish – we will give you the tools and the knowledge to realise it. Start with a single sensor, learn how it works and then apply that knowledge to your build. The online resources have all of the code snippets for you to add to your code, and our robot.py file contains every function for every sensor we create in this tutorial.

Additional features

In part two, we created a series of motor tests (forward, backward, spins, stops) but we left one out. This isn't so much a test, rather a routine that our robot can follow when it encounters an



Our robot can see, well, sort of. It uses pulses of sound to detect objects. But we can also use infrared or a good ol' button to detect an obstacle.

immovable object. The routine is called `make_space` and its goal is to back the robot away from an object, spin and then try again. It is a function that calls the other motor functions.

Open the `robot.py` module in your favourite editor and add these steps.

Create a function called `make_space`:

```
def make_space():
```

First we tell the robot to stop, and print that to the Python shell before waiting for one second:

```
print("stop")
stop()
sleep(1)
```

Then we send the robot backwards at half speed for one second:

```
print("backward")
backward(0.5)
sleep(1)
```

We then stop again for a second:

```
print("stop")
stop()
sleep(1)
```

We spin the robot left at half speed for 200 milliseconds. Alter this to meet your requirements:

```
print("spin left")
spin_left(0.5)
sleep(0.2)
```

Finally, we stop the robot:

```
print("stop")
stop()
```

Once these steps are complete, the robot can continue on. If there is another obstacle, the routine can be called again. Save

the function to `robot.py`. Later, we will use this function as a means of helping our robot escape a situation.

Plenty to sense

The world of electronics has a dizzying array of sensors. We can measure acceleration forces, magnetic fields and orientation. But the best sensors for a robot are those that give it the ability to sense the world around it. We can start basic with a bump sensor, essentially a button, then work our way to distance sensors, which use pulses of sound to measure our distance from an object. Remember that we don't need to use every sensor on our robot; choose the sensor(s) that will complement your build. At the end of this part, we will have updated our Python module to feature new functions for working with each sensor.

Bump it!

Bump sensors are the most basic of robot sensors. Really, they aren't a sensor in the truest form. Rather they are simply buttons that when pressed trigger an action to happen. Just like the buttons on a game controller. Our bump sensor can be an arcade button glued to the front of the robot chassis. As the robot touches an object, the button is pressed and the state of a GPIO pin is changed. In our case, the



GENIUS TIP!

By creating a module full of functions, we have created our own, high-level interface for controlling the robot. There is no right or wrong way to control it; use the functions to create your own sequence of commands.

GPIO pin is pulled high when the button is not pressed. Pressing the button connects the button to GND, causing the GPIO pin to go low and triggering a function that stops the motors, then reverses.

The circuit for the bump sensor is a simple two-wire connection. One leg of the button connects to GPIO2, the other to GND. It doesn't matter which leg. We used a large arcade-style button for this as it is designed to take high impacts and we can easily attach it to the front of the robot. The button needs to be proud (stuck out) from the front of the chassis so the button hits the object before the robot.

Going to the code and inside the Python module, `robot.py`, that we created in part two, we now need to add a few more lines of code. We edit the first line, which imports classes from the GPIO Zero module. We already have `PWMOutputDevice` that we use to control the motors, now we add `Button` to the line.

```
from gpiozero import
PWMOutputDevice, Button
```

Scroll down the code to the end – our last function was `stop()`. After this function, create a new function called `impact`:

```
def impact():
    Print IMPACT to the Python
    shell. This is useful if you need to
    do any debugging.
```

```
    print("IMPACT")
    Call the stop function to pull
    an emergency stop:
    stop()
```

We then reverse the robot at half speed for two seconds. This gives us a little space between the obstacle and the sensor:

```
    backward(0.5)
    sleep(2)
```

Save the code to the module, `robot.py`. Now create a new file, called `sensor-test.py`. This is the test file for this input. We start by importing the `Button` class from GPIO Zero:

```
from gpiozero import Button
```

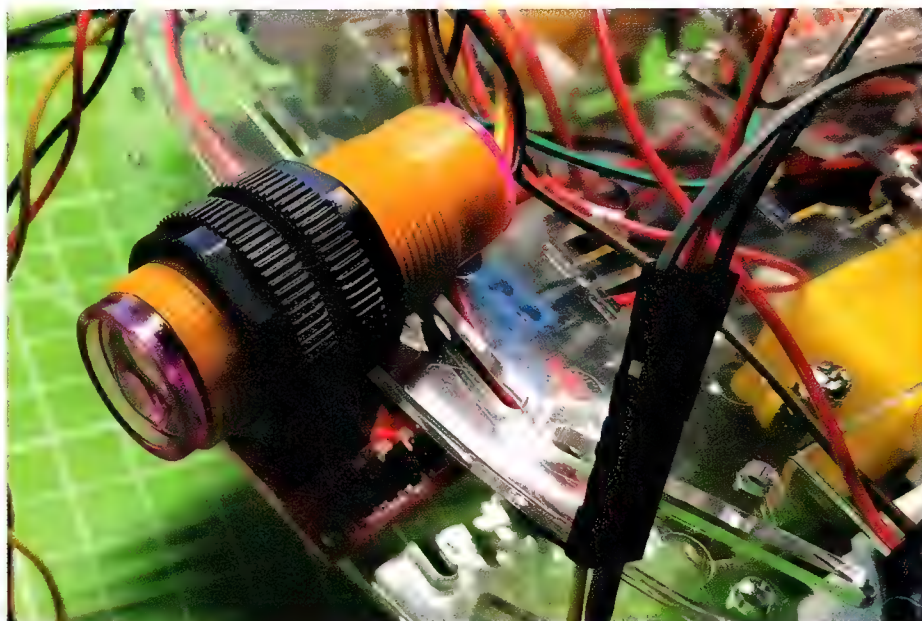
Next we import `pause` from the `signal` module. This prevents the code from exiting during our tests:

```
from signal import pause
Import our robot module.
import robot
```

Create an object, `button`, which links our hardware button to the code:

```
button = Button(2)
```

When the button is pressed, set the code to call the `impact`



function from the robot module:
`button.when_pressed = robot.impact`

Finally, we need to call the `pause` function to prevent the code from exiting:
`pause()`

Save and run the code. Quickly press the button to trigger the `impact` function to run. We've just created our first, basic sensor for the robot.

Passive infrared

Passive infrared (PIR) sensors are a common sensor in maker electronics. The sensors, typically `BISS0001`, are simple to use and relatively reliable. They are used to detect movement using infrared. Everything emits a low level of IR radiation, and this sensor is designed to detect changes, such as a person or animal moving into its field of view. When triggered, the output pin moves from high to low, giving us an event that we can use to trigger an action. Standard golf ball-shaped sensors are better used for alarm projects, but PIR obstacle sensors can be used as a crude means to detect objects and people.

We used an obstacle sensor specially made for robotics. It uses the same basic premise as a typical PIR sensor, but has a shorter and narrower field of vision. The detection distance can be tuned using a potentiometer (a screw) on the back of the sensor.

The sensor (see top-right) has three pins: power (VCC), out and GND. Typically these are identified by their colours (red,

yellow and black, respectively). The red wire connects to 3.3V on the Pi, black to any GND pin, and yellow, the out pin, connects to GPIO4. See the diagram `Obstacle.png` in the project downloads.

With the sensor connected, we need to add a few lines of code in order to make it work. This code is added to our `robot.py` module, which contains all the commands to make our robot work. Firstly, we need to update the `GPIOZero` import so that it now includes the `MotionSensor` class:

```
from gpiozero import
```

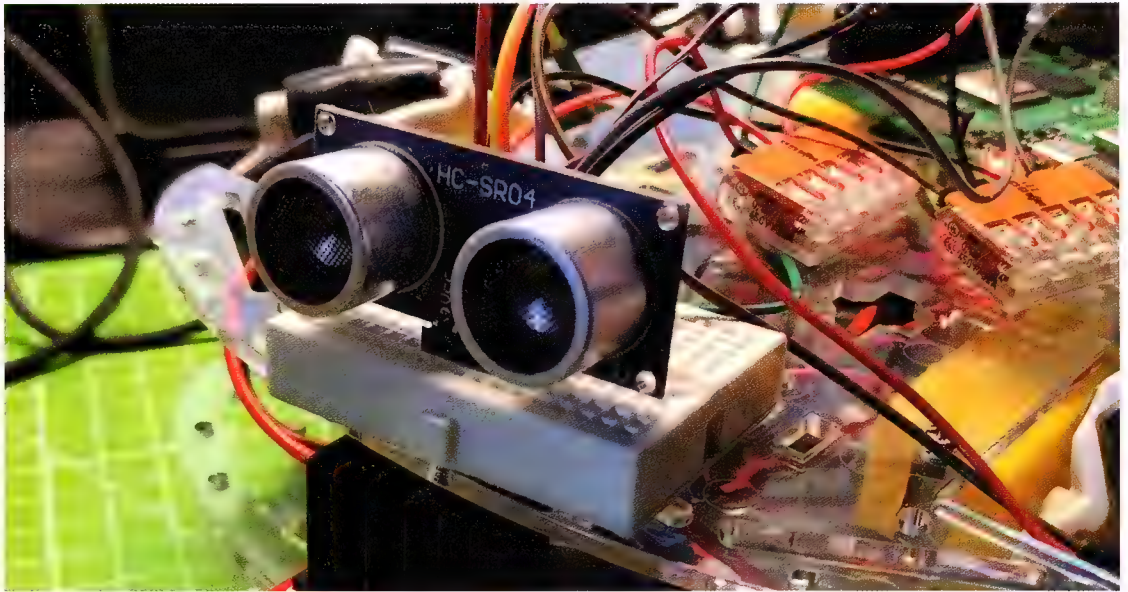
Obstacle sensors are really PIR sensors that have a narrow and short field of vision. We can use them to detect walls, people, pets and so on, and have the robot react accordingly.

SENSOR KITS

You can spend lots of money on sensors and, over the years, we have done just that. If you are starting out, it is best to pick up a kit of different sensors. These kits can be found on Amazon for \$35-\$60 and come with a plethora of components, including many that can be used in non-robotics projects. Tilt switches, photo-interrupter, avoidance, flame and lasers can all be yours, thanks to these handy kits. Our advice is to pick one up and use it to experiment with the sensors and your Pi. But we also suggest you pick up an `HC-SR04P` (or `+`) instead of the bundled `HC-SR04`. The `HC-SR04` requires a potential/voltage divider, consisting of two resistors, which drops the output (echo) pin's voltage down from a damaging 5V to 3V. Never use an `HC-SR04` on a Pi or Pico without a voltage divider or a logic level converter. Save the hassle and get the `P/+` variant instead.

If you fancy something more sophisticated, a time-of-flight array is great for measuring distances with more accuracy. The `VL53L5Cx` has an 8 x 8 array that uses lasers to measure distances between 2cm and 4m. This tiny sensor can return values and basic shapes instead of distances, giving your robot a greater understanding of the world around it.

Ultrasonic sensors are the easiest and best way to give your robot sight. The new P and + models work out of the box with the Raspberry Pi and Pico.



PWMOutputDevice, Button, MotionSensor

Underneath where we configured our motors (rra, rrb and so on), we need to create a new object, obs (short for obstacle), which uses the MotionSensor class to configure the sensor on GPIO4:

```
obs = MotionSensor(4)
```

Scroll to the bottom of the file, past the impact function, and create a new function called obstacle:

```
def obstacle():
```

Inside the function, we use **print** to write a message to the Python shell, informing the user that the sensor is searching for an object.

```
print("Checking for object")
```

When it 'sees' an object, it triggers the sensor to change state, and in this case it runs the **stop()** function to immediately stop the robot. We use **when.motion** because the obstacle sensor and a standard PIR sensor

work in the same manner.

```
obs.when_motion = stop
```

Save the code and open **sensor-test.py**. Clear any existing code as we are going to create a new test just for the obstacle sensor. Import the robot module:

```
import robot
Call the obstacle function:
robot.obstacle()
```

Save the file and click Run to start the test script. The function runs and prints **Checking for object**. Place your hand in front of the sensor. The LED in the sensor lights up, the Python shell prints **STOP!** and the stop function halts the motors. We have successfully tested our obstacle sensor.

Ultrasonic the robot

You're reversing the car and hear a "beep, beep, beep". As you get nearer to the garage door, you hear "BEEP!" That is a distance sensor. It sends a ping of ultrasound at 3,440cm/s, and waits for the returning echo. The

time taken for the ping to send and receive is halved, then multiplied by the speed of sound to give distance.

The common distance sensor for Arduinos and Raspberry Pi is the HC-SR04. We're using the HC-SR04P (or you can use the + model) as it is compatible with the 3V logic used by the Pi's GPIO. The older HC-SR04 uses 5V logic, and requires a potential divider to drop the echo pin's output from 5V to 3V. In the past, we have hand-coded our own function to calculate and return the distance, but luckily GPIO Zero has a built-in function, **DistanceSensor**, that removes the maths from our code. That said, learning how to write your own function to handle this is a basic skill for most robot makers.

Going to our code and inside the Python module, **robot.py**, that we created in part two, we need to add a few more lines of code. We edit the first line that imports classes from the GPIO Zero module. We already have **PWMOutputDevice** that we use to control the motors, and now we add **DistanceSensor**:

```
from gpiozero import
PWMOutputDevice, DistanceSensor
```

Next add an object, **sensor**, underneath where we defined the motors (rra, rrb, and so on). This specifies the GPIO pins used for the sensor, in this case GPIO27 and 17. Pin 27 is our echo pin, 17 the trigger:

```
sensor = DistanceSensor(27, 17)
```

Now we go right to the bottom of the code and create a function, **ultra** (short for ultrasonic):

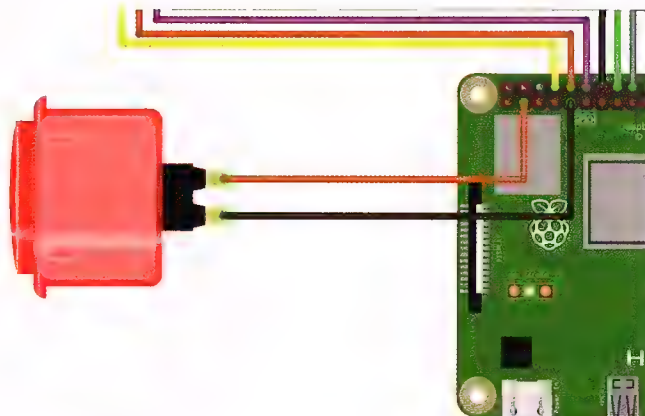
```
def ultra():
```



GENIUS TIP!

For Raspberry Pi and Pico-based robotics, look for HC-SR04P and HC-SR04+ ultrasonic sensors. They work out of the box with the Raspberry Pi and can be used with 3V logic (Micro:bit, Adafruit, ESP8266 and so on) and 5V logic (Arduino) boards.

Bump Sensor



Our bump sensor is really an arcade button, designed to take high impacts. When the button is pressed, it completes a circuit and changes the state of a GPIO pin, causing an action to happen.

The function first creates an object, distance, and in there it stores the distance measured. Note that the function returns the value in metres, so we multiply the values by 100 for centimetres. We use `round` to round the measurement to two decimal places.

```
distance = round(sensor.  
distance*100,2)
```

Print the distance as part of a sentence to the Python shell:

```
print('Distance to nearest object is',  
distance, 'cm')
```

Use a conditional test to check the distance. If it is below 50cm, call the `make_space` function that we created earlier:

```
if distance < 50:  
    make_space()
```

Rise of the robots!

We've tinkered with the sensors and now it is time to put our tinkering to the test with a basic script that uses the ultrasonic sensor to measure the distance of objects ahead of our robot. If an object is less than 50cm away, the robot stops, spins and backs away before trying again. Tweak the detection distance via the `ultra` function in `robot.py`. We chose 50cm as a conservative estimate so it triggered the `make_space` function; 10-20cm would be better in the home.

Create a new file called `autonomous_test.py` and import the robot module:

```
import robot
```

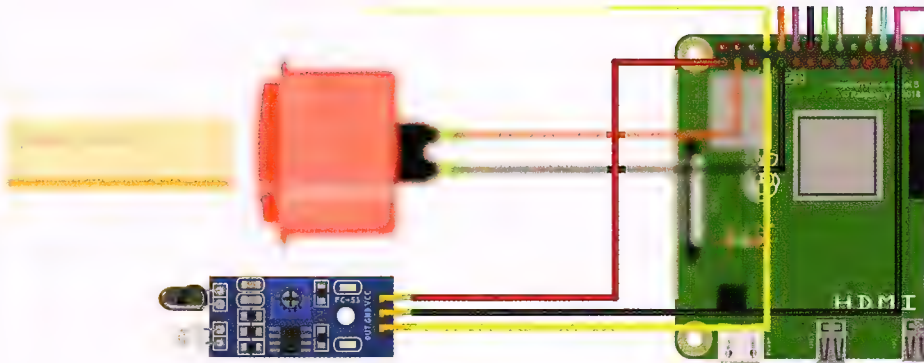
Use a try exception handler to run the main body of code. If this fails, an exception prevents the robot from running away:

```
try:
```

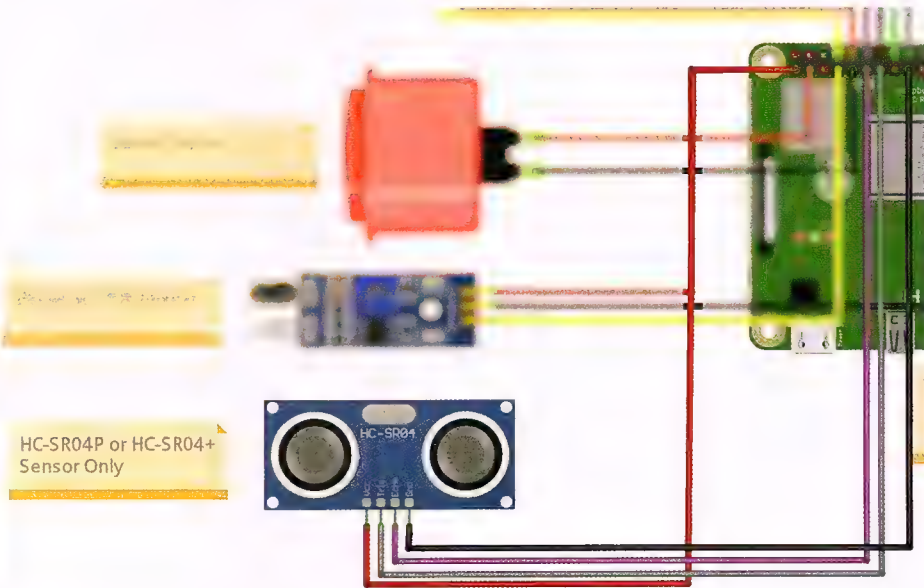
Use a forever, while True loop to run the code:

```
while True:
```

Call `robot.ultra` to run the ultrasonic sensor, check the distance and use the conditional logic inside the function to decide whether to move forward



The obstacle sensor has three pins: VCC for power, GND and a data/output pin, which changes state when it detects a person or object.



Ultrasonic sensors have four pins: VCC for power, GND and a trigger pin to send a pulse of sound, plus an echo pin to listen for the returning pulse.

```
or escape:  
    robot.ultra()  
    Here is where the exception  
    handling kicks in. Should the  
    worst happen, we can press  
    Ctrl-C to stop the code, print a  
    message, stop the motors and  
    exit:  
    except KeyboardInterrupt:  
        print("STOP")  
        robot.stop()  
    Save the code and click Run to  
    test it. Lift the robot off your  
    desk, otherwise you will be  
    chasing it around the room.
```

Press Ctrl-C to stop the code and robot.

Where are we?
We now have a series of sensors that we can use with our robot. Our choice was the ultrasonic distance sensor, chiefly because this sensor is so easy to use and provides our robot with great long-distance sensing and obstacle avoidance. Tinker with the code, and make it your own. Remember, this is your robot. ■

MOUNTING SENSORS TO A ROBOT

Placing sensors on your robot can be tricky. Ultrasonic sensors need to face forwards, bump sensors can be placed around the chassis, line followers need to go under the chassis. But how do we connect them all to the chassis? Your approach depends on what resources you have. We can glue sensors to the chassis, using cable ties to provide strain relief to the jumper wires. Gluing Lego bricks to the chassis and using them to

make a frame is one way to secure your sensors. We can fabricate our own frames using balsa wood, or laser cut our own frames if we have access to a makerspace. The best approach is to 3D print holders or frames for our sensors, and the best thing is, many people have done so and shared their models online. Libraries such as <http://printables.com> and <http://thingiverse.com> have an overwhelming number of 3D printable

holders for our sensors, many of which don't take much time to print. Sure, you need a 3D printer, but they're coming down in price. Creality's Ender 2 Pro is a solid performer for around \$260. We know, because we own one. Downloaded parts can be tweaked to suit your needs. Tinkercad is an excellent online resource to tweak 3D models. We can also use Blender, OpenSCAD and FreeCAD to edit and make our own parts.



GAMES

Hogwarts Legacy

The best Potter game yet, its scope and detail is astounding.

■ \$89.95 | PC, PS4/5, XB1/S/X, Switch, Android | hogwartslegacy.com

I was over 20 hours into *Hogwarts Legacy* before it revealed that, on top of being an expansive RPG with skill trees, wizard combat, crafting, environmental puzzles and loads of sidequests, it's also a quaint home decorating game with a splash of zoo management. This is a much larger game than I think anyone was anticipating and as I've completed the main quest and dozens of sidequests over 50 hours, I'm still surprised by how good each individual element is.

It suffers from a meandering start and distracting technical issues, but once I was set free to explore the entirety of Hogwarts and miles of countryside surrounding it, I enjoyed *Hogwarts Legacy* in the same ways I did *The Witcher 3* or *Red Dead Redemption 2*: moseying across a convincingly rendered world at my own pace, letting myself disappear into a character I'm invested in.

Like those open world classics I just mentioned, *Hogwarts Legacy* is a game you've probably played before, but also a rarity: a big-budget RPG attempting to bottle up all of the prestige, splendour and

expectations of a massive media property into a seamless sandbox. For the most part, it nails it. This is Harry Potter's *Arkham Asylum* moment – a game telling its own story in an established world, unshackled by the restrictive deadlines and creative boundaries of a movie tie-in.

Magical balance

Hogwarts Legacy isn't written by JK Rowling or directly adapted from her stories. In fact, Warner Bros and Portkey Games (the game publishing arm of Harry Potter properties) go as far as to say that she was "not involved in the creation of the game" at all. Still, it's built upon the world that she created and inherits some of its problems, particularly its portrayal of goblins and house elves.

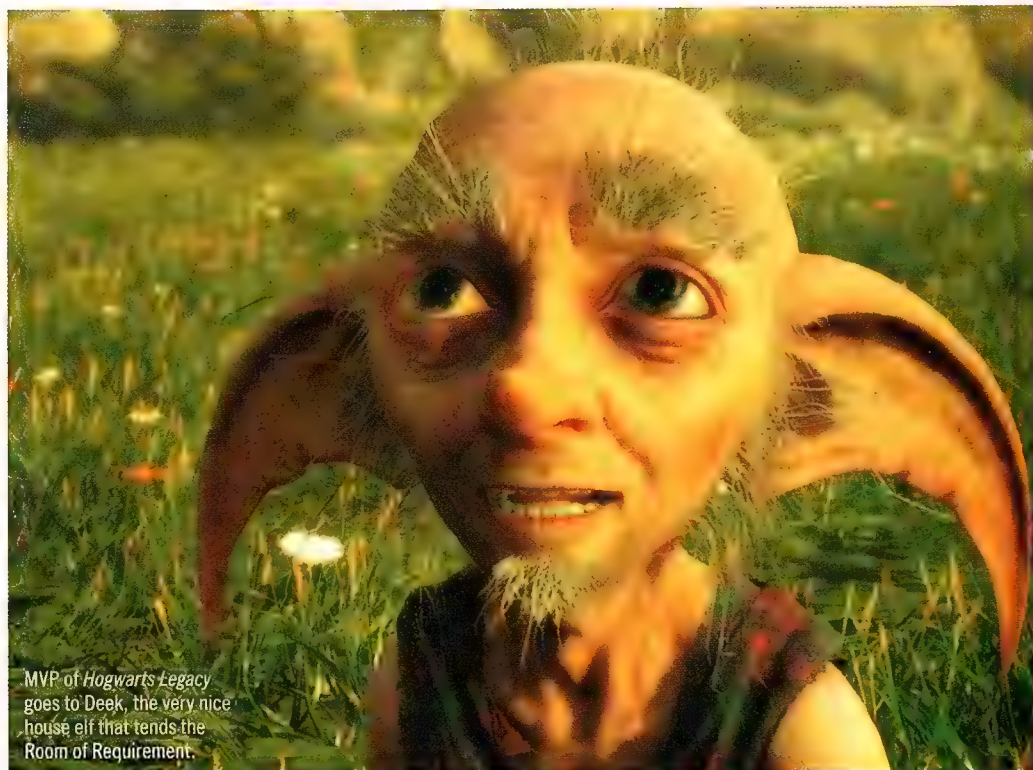
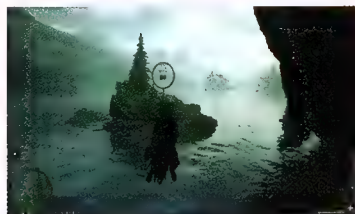
Still, Avalanche Software have built a rich, almost annoyingly detailed world that routinely exceeds its source material in terms of quality and inclusivity. *Hogwarts Legacy* is full of simple but harmonious systems that keep things fun at all times.

Wizard duels are a unique take on

ranged combat where no aiming is required but spacing, dodging, and countering is key. Think Batman with cooldowns (and more murder). Your clothes, cloaks, scarves, facewears and hats have *Destiny*-like offensive/defensive stats, but you can just set your cosmetic look to whatever you want. You also do a whole lot of talking, often with two or three dialogue choices that express a chosen personality within bounds (but only rarely seem to influence the outcome of interactions). I was especially surprised by the Room of Requirement: a personalised living space for your wizard with an almost *Animal Crossing*-level of decoration options. Eventually, it gets a lot bigger.

Being there

The single most impressive aspect of *Hogwarts Legacy* is Hogwarts itself. Developers love to describe their games as "living, breathing worlds" but it's difficult to think of any better way to characterise the titular castle. You can't walk ten feet without a part of Hogwarts castle coming



MVP of *Hogwarts Legacy* goes to Deek, the very nice house elf that tends the Room of Requirement.

Left: Players are offered a house based on a simple Q&A, but you can ultimately choose which one you join. Above: Flying your broom (just about) anywhere you want is a major highlight of *Hogwarts Legacy*.



Potion brewing isn't as hands-on as in past Harry Potter games, but it does look cool.



alive: books reorganise themselves on shelves, suits of armour salute passers-by, hedges trim themselves to perfection, ghosts float around telling jokes, textbooks flutter above passing students, and paintings animate or converse as if the MOMA switched to the .gif standard.

The beginning hours of *Hogwarts Legacy* immersed me pleasantly in the life of a student: attending classes, making fast friends and getting up to some harmless teen mischief like sneaking into the library after hours. I loved that learning new spells was organically weaved into these personable cutscenes and looked forward to every return trip to

Potions or Defence of the Dark Arts.

If the plot of *Hogwarts Legacy* is starting to sound like its source material, that's because it's basically Harry Potter set to 1.75x speed. The parallels go beyond coincidental and well into distracting: a protagonist who quickly proves to be a uniquely gifted wizard, gets loads of special attention and perks from professors who supposedly have hundreds of other students (does every student get to craft a home base inside the Room of Requirement, or is it just me?), and wields a unique power that constantly lands them in real danger from villains.

When Harry and Voldemort square off

in their final battle at the end of *The Deathly Hallows*, magical combat looks sort of boring. They're glaring and grimacing as they point sticks at one another without moving their feet, sort of like a very boring episode of *Dragon Ball Z*. But thankfully, *Hogwarts Legacy* manages to make magic cool. That's partially because, instead of returning to the stilted stationary wand combat of the old Harry Potter games, *Hogwarts Legacy* takes a cue from its fellow Warner-published Batman games.

The spell is cast

Hogwarts is a very easy game (so much that I recommend everyone give the hardest difficulty a try), but I never got bored of swapping between my dozen-plus spells to slice, burn, freeze, explode, or curse jerks into the ground.

Hogwarts doesn't have the luxury of just being a videogame. It's so rare that we get a licensed, blockbuster game like this – one that mostly delivers on the enormous scale of an intricate fantasy world that's had decades to develop in our minds and on film.



Your investigation of ancient magic begins before ever stepping foot in Hogwarts.

Hogwarts Legacy is a great game with plenty of sidequests and puzzles.

Morgan Park

★★★★☆



apc
HIGHLY
RECOMMENDED

ATOMIC HEART

A beautiful, flawed, and deeply weird Soviet Westworld.

■ \$89.95 | PC, PS4/5, XB1/S/X | mundfish.com

Atomic Heart will leave you grasping for purchase, as it freewheelingly veers from enormous set pieces to endless fetch quests, as critiques of Russian exceptionalism rub up against a protagonist who calls robots “fat turds” and a script written with the help of a swearing thesaurus.

This is one of the oddest big-budget games I’ve played in a long time, filled with as many good ideas as bad ones, like it’s been made without a filter and everything went in. The game’s influences are numerous – *Westworld*, *Fallout*, *Arkane’s Prey* – but the one that looms above them all is *BioShock*.

Atomic Heart’s narrative-focused opening is like a communist version of Columbia and the grandeur of its sprawling research institute, a utopia-gone-wrong showcasing the best of retro-futurist Soviet robotics, makes for one breathtaking vista after another. But the influence runs far deeper than aesthetic. Combat is built around a plasmid equivalent, several lifted

straight from *BioShock*, while the narrative style of first-person talking heads, radio logs, and companions is straight from the Irrational playbook. *Atomic Heart* almost pulls it off.

BioShock starts you off with a wrench and an electric shock attack, and *Atomic Heart* does more or less the same but with an axe. The difference is that *Atomic Heart’s* electric shock feels... well, like it’s just giving things a tickle. The combat has fairly standard basics (a melee weapon, a pistol, a shotgun, a grenade launcher) but is nuanced by some great individual twists, like the zappy pistol you can upgrade into a death-dealing chargeable shock beam. You can customise your weapons into various damage types (electrical damage for robots, bleed damage for organic foes) and secondary effects like knockback or AoE. But ultimately no matter how you choose to skin *Atomic Heart’s* android enemies, combat lacks the heft of its inspirations.

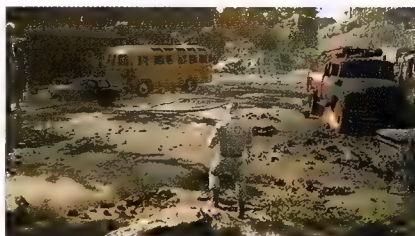
Atomic Heart is bursting with ideas,

and some of them are great and some are ballast that only end up making the good stuff weaker. Despite my criticisms the combat is often exciting and tense. Still, this combat system never quite hits the heights it promises. It’s like all the ingredients are there but the cake’s still that tiny bit under-baked. Towards the end of *BioShock* and its sequels you feel like an all-powerful terror, a genetic monstrosity that swats splicers like flies. In *Atomic Heart* your power level amps up without ever reaching that point of potency.

Atomic Heart is a surprising, ambitious, deeply flawed game that at times feels close to greatness. It will take your breath away with a set piece one minute, then make you spend the next ten fiddling with an annoying puzzle while the protagonist swears about how annoying this puzzle is. It’s unbelievably crass in one breath, then delivers a cogent summary of contemporary issues around AI the next. I have no doubt it’ll become some sort of cult classic among a particular type of FPS player.

Atomic Heart is ambitious and gorgeous, but boils down to a tonally inconsistent Soviet *BioShock*.
Rich Stanton

★★★★☆



RETURNAL

A roguelike shooter at war with its own identity.

■ \$94.95 | PC | tinyurl.com/APC519RET

Returnal is a big budget roguelike that kicks off a new era for the Housemarque studio. Strictly speaking, it's a third-person roguelike shooter – the camera tight over your shoulder, not high above, with runs progressing you through a shifting alien world, rather than being an opportunity to chase high scores. But the more you play, the more it feels like a wolf in sheep's clothing, using some of the trappings of a popular modern genre to smuggle in the gameplay.

Things kick off with an astronaut – Selene – crash-landing on the alien planet of Atropos. After some fraught encounters with the hostile wildlife, she discovers she's trapped in a time loop – if she dies, she simply wakes up again at the crash site.

Combat is fast, frantic and deadly, a furious, leaping dance of aliens and projectiles. Survival means always being on the move, and avoiding getting hit at all costs so you can maintain your vital Adrenaline – a stacking buff that vanishes if you lose any health.

It's exhilarating stuff, chaotic enough to always keep your blood pumping, but precise enough to demand mastery. Even the visuals evoke a meeting of two worlds. The alien landscape is bleak and weird,

taking clear inspiration from the *Alien* films.

Elsewhere, unfortunately, the game struggles to find a similar balance. Despite the roguelike structure, there's a clear reluctance to let the RPG elements common to the genre have too much effect on the very skill-based combat. There's almost no persistent progression, and even

within a run, boons that you earn frequently feel minor. The result is that it's very possible to die after 40 minutes of play having made no progress at all in your overall goal.

When you're bouncing between platforms, blasting

aliens and dashing through their attacks, it looks and feels excellent. But actually making progress demands far more patience than is really fair to ask. A certain breed of dedicated gaming masochist will revel in *Returnal*'s unwavering challenge, but I suspect most will wish there were more meaningful RPG elements.

Demanding but excellent combat and gorgeous visuals sit awkwardly in a half-baked roguelike structure.

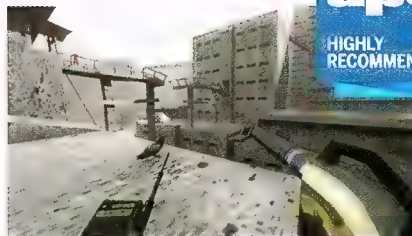
Robin Valentine

★★★★☆

"It's exhilarating stuff, chaotic enough to always keep your blood pumping, but precise enough to demand mastery."

apc

HIGHLY
RECOMMENDED



BABBDI

Explore a bleak, brutalist city.

■ Free | PC, Mac, Linux | tinyurl.com/APC519BABBB

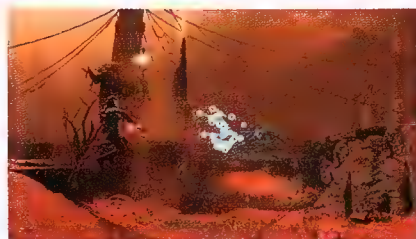
At its core, *Babdbdi* is an exploration game, set in a surreal and downcast world that brings to mind *Pathologic*, *Half-Life 2*, and a neglected council block. You might call it a walking sim, but to see everything you'll need to do more than walk – you'll need to jump, climb, hover and fly, and even ride a motorbike if you can find one. I say *Pathologic* because of the bleak, oppressive air and cast of strange inhabitants, and *Half-Life 2* because it's a wonderfully interactive dystopia. There are a range of tools you can find that will aid your exploration, or that you can just pick up and muck around with, like the playable trumpet.

It's a game about unlocking the world, as you gradually map the contours of its brutalist playground. First you stumble across that vacuum cleaner – or perhaps you find the torch, which will let you delve into the darkest corners of the city. The ultimate prize for your exploration is one I shouldn't spoil, but it's a cathartic moment on a par with that bit at the end of *HL2* with the powered-up gravity gun.

An enjoyably interactive and vertical exploration game, set in a grey and gloomy city stuffed with secrets.

Tom Sykes

★★★★☆







GAME CHANGER

Neverwinter Nights

A DnD fantasy epic that changed the RPG rulebook. By Robert Jones

■ Release: June 18, 2002 Developer: BioWare Publisher: Infogrames Link: bit.ly/2jnBbhv

Why did I reinstall *Neverwinter Nights*? First and foremost it is so I could relive its classy, beautifully written and emotional main narrative once again.

A brief synopsis. Awakening in the city of Neverwinter as a recruit summoned to help deal with its deadly crisis, the Wailing Death plague, which has ravaged the city and left piles of corpses in the streets, you the protagonist are soon introduced to Lady Aribeth de Tylmarande a half-elf paladin of Tyr, the Blind God of Justice.

Lady Aribeth is protector of the city and its ruler Lord Nasher Alagondar. She is also in love with Fenthick Moss, a cleric of Tyr, who she holds very close to her heart. To help Aribeth the player is tasked with tracking down a series of Waterdhavian creatures, which are stolen from the city in the game's prologue. From these creatures a cure can be made for

the Wailing Death, but upon finding the creatures and a cure for the plague being fashioned, Fenthick's superior cleric of Tyr, Desther Indelayne, betrays the entire city and steals the cure.

Desther, who it is revealed is part of a sinister cult, is eventually apprehended and executed for his crimes. But as he goes to his grave he takes Fenthick Moss with him, who though innocent and having nothing to do with the cure's theft or the release of the Wailing Death plague, is deemed guilty by Alagondar by his close association and executed. Fenthick is hanged from a tree outside the city gates.

The fallout from this is terrible, but brilliantly written and makes for an incredibly compelling story. Aribeth, who has had her true love taken from her, and her destined future extinguished, loses her faith, sides with the true enemy of Neverwinter and, in a fantastic

Above: Wrangling the camera can still be a bit of a mission.

twist, turns against the city and leads a full-scale assault against it, with revenge against those who wronged her so badly now her glorious purpose, her new faith. And into all this you, the player, the Hero of Neverwinter, must wade, and bring about resolution.

Yes, the story really is that epic, and a great reason alone to experience *Neverwinter Nights*, either as a reinstall or for the first ever time. The very human element that sits in the centre of its plot really helps ground it and stops it getting lost like so many fantasy RPGs do in grandiose war and politics. But a fantastic core narrative is far from all that makes (and made upon its original release) *Neverwinter Nights* a classic.

Rolling a D20

When *Neverwinter Nights* released back in June 2002, it raised the



benchmark for RPGs like few games had done up till that point and, arguably, have done since.

This was a game from a firm in BioWare that had made its name by producing RPGs, indeed some of the very best games of the genre anyone had ever seen, such as the seminal *Baldur's Gate* and *Baldur's Gate II*, and was in the early 2000s right on the top of its game.

But still, what BioWare went on to do with *Neverwinter Nights* was truly astonishing. Not only did it deliver that classy, sumptuous, complicated narrative fantasy adventure that it had made its name with prior, but it also pushed the technical boundaries of what games could look like and deliver, with *Neverwinter Nights* coming with the actual Aurora toolset editor used to build the game by its developers.

Out of the box gamers could not only enjoy a fantasy RPG based on a full-fat but expertly streamlined virtual version of *Dungeons & Dragons*, but they could actually build their own further adventures, too. And, what's more, *Neverwinter Nights* also delivered multiplayer support and a Dungeon Master client, too,

meaning you could not just create extra adventures but play them with your friends as well.

BioWare had delivered not just the ultimate 60-hour-plus fantasy RPG adventure out of the box, but the ultimate RPG maker, too, and

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delivered a way for gamers to enjoy these adventures together. Today that may not sound so impressive, even though few games today deliver anywhere near that total package in my mind, but back in 2002, when multi-person PC gaming was very firmly still in local LAN-mode due to the infancy of broadband internet connections, it was magic.

And that's saying nothing of the fact that in just two short years BioWare had moved from the isometric 2D Infinity Engine to the fully 3D Aurora Engine, which set new standards at the time for gaming fidelity, pushing the day's best graphics cards to the max.

Ahead of its time

Replaying *Neverwinter Nights* today, though, also highlights to me another key way BioWare was ahead of its competitors. What's interesting is that unlike the RPGs it had made before, here you don't assemble and control a huge party of team members, such as in the *Baldur's Gate* series, as well as other fantasy RPGs of the period such as *Icwind Dale*, but instead you simply create and play as your own central character and then, if



Left: More demanding fights definitely benefit from tactical pausing
Top right: The game is built on the 3rd edition D&D ruleset.



you so desire, can enlist the support of one other NPC crew member.

This greater focus on just the player character is notable as it seeds the sort of gameplay experience and systems that would go on to be used in games like *Star Wars: Knights of the Old Republic* and *Mass Effect*. The ability to select a more dynamic, follow the player, over the shoulder-style camera system shows this, too, even though most gamers likely opted for a more traditional bird's eye isometric viewpoint.

But this streamlining of how accessible and approachable such a vast and deep RPG as *Neverwinter Nights* is now screams to me as the start of the modern era of RPGs, where the powerful but complex and sometimes finicky user interfaces and mechanics of 1990s RPGs were replaced with alternatives that could be used by most gamers.

The result is that *Neverwinter Nights* is still incredibly approachable today in 2023, even if you've never played classic PC RPGs. In fact, because of its streamlined approach to core

gameplay, with the player only needing to really look after themselves and, very lightly, one companion NPC, it's even more streamlined to play than many RPGs that came after it, such as *Dragon Age: Origins*.

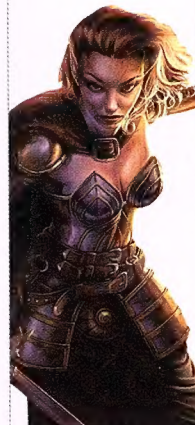
It's absolutely not an action RPG in the mould of *Mass Effect*, with spacebar pausing the action whenever you wish and action taking place firmly with turn-based invisible dice rolls, but unlike many RPGs of the 1990s and 2000s, you really can approach this game in a more casual way. There's a few old-fashioned difficulty spikes that require a more considered approach throughout the game, but in general you can run, slash, shoot and zap your way quite easily through the foes the game throws up. That's really refreshing, as so many old games suffer upon reinstall from now long-forgotten complexity issues.

Class is permanent

Obviously, there are areas of *Neverwinter Nights* that, even post-enhancement, feel a bit jarring today. The camera, across its various modes, remains a

frustrating beast, needing to be manually wrangled into position a lot, and inventory management can often feel like a chore, too. There are also no 'you need to go here' quest markers, or magical guides to carry you brainlessly to your destination, so you need to be comfortable reading quest entries in your journal for clues and instruction. And, while players do have to pay attention to their character class's strengths and play into them to be successful, *Neverwinter Nights* is comfortably modern in how forgiving it is.

In our original *Neverwinter Nights* review back in 2002, we gave the game a stonkingly high score of 94%, concluding that, "*Neverwinter Nights* is at the very forefront of not just its genre but the very medium of gaming." And that while, "*Neverwinter Nights* might sound like a frighteningly complex title, like all the best things, it's a complicated thing made comparatively simple." I feel today that these qualities, along with its enduring open platform for creating and enjoying extra content, make it stand-up still as a truly fantastic RPG to while away whole weeks in. ■



CHIP CHAT

JOEL BURGESS REPORTS ON THE UNUSUAL SIDE OF TECH NEWS

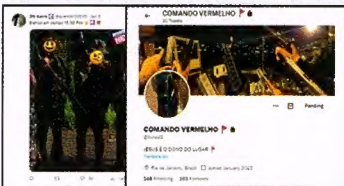
© David Garrett / Syntiant / Pixels

**TINY NEURAL CHIP IS A DEADEYE AT DOOM**

The AI processor also does it using a thousandth of a Watt.

Doom is the gold standard in low-demand games that you can play on everything from a calculator to a tractor. We know that you can power a playable version of the game using rotting potatoes as batteries, but one thing we hadn't seen Doom do till now is be played by an ultra low powered AI chip. Since AI can currently write a better history essay than most of us these days, it's hardly surprising that it's adept at nailing headshots to monsters, but doing it using just 1 milliWatt of power is impressive. That's about 500 times less power than those potatoes needed to generate to run the game.

© Alliance to Counter Crime Online

**MUSK'S TWITTER HAS REINSTATED MANY PROBLEMATIC NARCO GANG ACCOUNTS**

Violent criminals running unchecked under Twitter's new minimal moderation policies.

While many revere Elon Musk for unwinding years of content policy development at Twitter since it makes the place a much more controversial and exciting platform, a new report by the Alliance to Counter Crime Online details some of the more serious consequences of taking a more lax approach to content moderation. The biggest concern is around the reinstatement of many narcotic gang Twitter profiles that were previously banned between 2012 and 2015. These gang related accounts post graphic warnings to rival gangs, help logistics and organisation, and glorify the narco lifestyle to attract new recruits, according to the report.



© DARPA

CHIP CHAT

AI can now pilot fighter jets

The US announces it can fly F-16s with AI and will have them dogfighting by 2024.

The States now have the capacity to use AI software to pilot military fighter planes according to an announcement in February by the US Department of Defense research agency DARPA. The AI was uploaded to a modified F-16 (X-62A) in December 2022 and was responsible for autonomously controlling multiple flights over a number of days according to the DRPA press release. An interview with a director of the Defense Program at the Center for New American Security published in The New Yorker suggested that four AI flown planes will participate in a live dogfight around Lake Ontario in 2024.

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